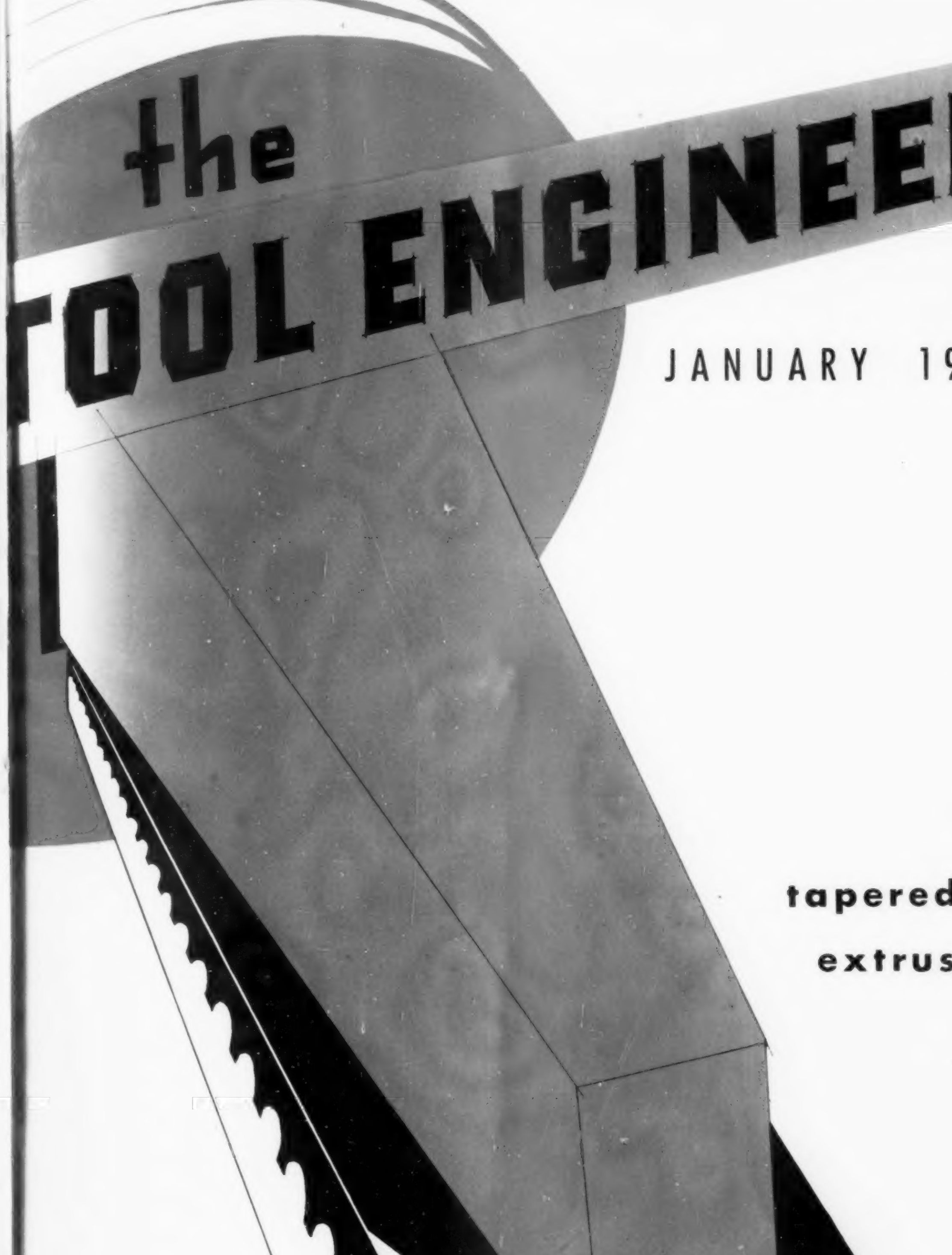
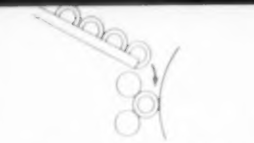
the TOOL ENGINEER

JANUARY 1955



tapered extrusions

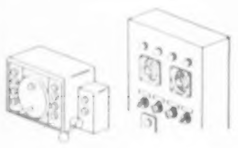
UBLICATION OF THE AMERICAN SOCIETY OF TOOL ASTE ENGINEERS



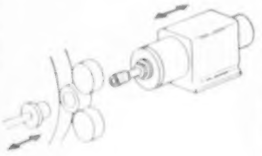
AUTOMATIC LOADING AND LOCATING IN CENTERLESS ROLLS

AUTOMATIC CHUCKING

AUTOMATIC LOADING AND LOCATING, CENTRI-MATIC

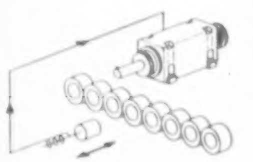


AUTOMATIC CYCLES

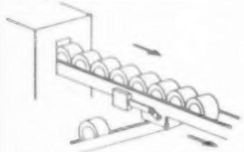


AUTOMATIC SIZING

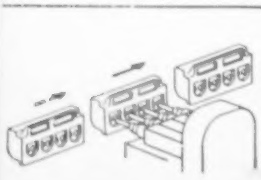
AUTOMATIC GAGING



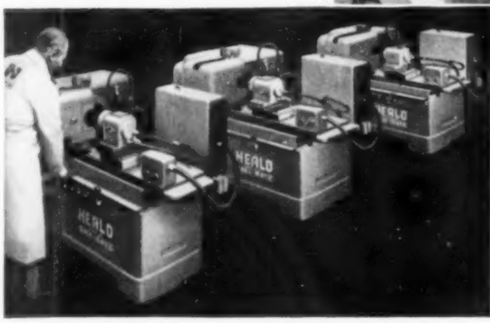
FEED BACK



AUTOMATIC HANDLING AND SORTING



Heald transfer-type Bore-Matic arranged for fully automatic drilling, reaming, boring and facing of valve seats and stem holes in automotive cylinder heads. Machine consists of a series of basically standard Heald way-leg units, sequentially machining the work through the various stations to the far end fully automatically.



Heald battery-type Internals permit fully autom operation of a bank of machines from a sin hydraulic power unit. One operator can easily te several machines.

How Heald AUTOMATIO

fits into your production plans

AUTOMATION is the newest trend in modern production efficiency. Yet it has occupied the attention of Heald engineers for many years. In fact a number of important developments contributing to fully automatic operation were developed here at the Heald plant more than a decade ago. And research on automation has progressed unceasingly, as witnessed by scores of fully automated transfer machines, way-type Bore-Matics and battery type Internals now operating successfully in the field.

This background of experience is at your disposal—ready to solve virtually any precision finishing problem, carrying it through in many cases from rough casting to finished part. Your nearest Heald representative will welcome an opportunity to show you how Heald AUTOMATION can step up precision and production, with important savings in time and cost factors.

You'll find that IT PAYS TO COME TO HEALD!

HEALD

THE HEALD MACHINE COMPANY ®

WORCESTER 6, MASSACHUSETTS

Offices in Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

…er: Aluminum extru-…ns can be shaped to any …er desired, minimizing …chining and reducing …p. Ernest de Ridder …cusses various forms of …trusions and their pro-…uction in his article be-…ginning on Page 69.

The Tool Engineer

Volume XXXIV, No. 1 **January 1955**

TECHNICAL ARTICLES

ASTE NEWS

DEPARTMENTS

THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and the *Industrial Arts Index*

ASTE

PLANNING · ENGINEERING · CONTROL · TOOLING · EQUIPMENT · PRODUCTION

How to Pick the Right Cutting Oil

WORD OF MOUTH?
It gives you the answer sometimes, but not many of your friends have the same cutting oil requirements and the same problems that you have. It's much surer to depend on specialists like Sun.

LABORATORY ANALYSIS?
Sure. But there's no formula for correlating the laboratory analysis with how well the cutting oil will work on your job. It takes years of field experience like Sun's to help you make the right choice.

ELABORATE SHOP TEST?
This will probably give you the answer. But it's expensive and interferes with production when you try to test all the oils available. Sun's experience can help keep your shop-testing to a minimum.

EXPERIENCE IS THE ANSWER.
And Sun has it. Its field representatives have probably come across problems similar to yours many times. If they haven't, its cutting oil specialists and metallurgical technicians are ready to help with your problem.

Soluble or straight, transparent or black, light or heavy duty—Sun makes the kind of cutting oil you need to handle your job at the lowest cost. For more information, call your nearest Sun office or write Sun Oil Company, Philadelphia 3, Pa., Dept. TE-1.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

SUNOCO

PHILADELPHIA 3, PA. • SUN OIL COMPANY LTD., TORONTO & MONTREAL

Refiners of famous High-Test Blue Sunoco Gasoline

Harry E. Conrad
Executive Secretary

Allan Ray Putnam
Publishing Manager

Editorial

John W. Greve
Editor

Ralph H. Eshelman
Associate Editor

Robert A. Wason
Associate Editor

Dorothy J. Taylor
Assistant Editor

Alfred K. Abbott
Assistant Editor

Nancy M. Houston
News Editor

Edith R. Saunders
Assistant News Editor

Michael Babala
Art Editor

Business

Clarence T. Etter
Advertising Manager
10700 Puritan Ave.
Detroit 38, Mich.

Austin G. Cragg
Eastern Advertising Mgr.
400 Madison Avenue
New York 17, N. Y.

Richard E. Cleary
Ohio Advertising Mgr.
Commercial Bank Bldg.
Berea, Ohio

Stanley F. Girard
Western Advertising Mgr.
540 North Michigan Ave.
Chicago 11, Ill.

Robert E. Ahrensdorf
Pacific Coast Adv. Rep.
1140 Wilshire Blvd.
Los Angeles 17, Calif.

Michael Jakesy
Production Manager

Fay H. LaRoue
Circulation Manager

THE TOOL ENGINEER

Executive & Editorial Offices:
10700 Puritan Ave.
Detroit 38, Mich.

Publication Office:
239 E. Chicago St.
Milwaukee, Wis.

THE TOOL ENGINEER is published monthly in the interest of the members of the American Society of Tool Engineers. Entered as second class matter, November 4, 1947, at the post office at Milwaukee, Wisconsin, under the Act of March 3, 1879. Yearly subscription for members, \$2.00. Non-members, \$6.00. Canada, \$6.50; all other countries, \$8.00 per year.

The Tool Engineer

Insidious Industrial Hazards

Harmful effects of noise have been recognized for a long time. Certain kinds of noises damage hearing and enervate workmen, even making them accident prone. Because the impairment to hearing is gradual and can only be measured over extended periods of time, industry has been wont to overlook the dangerous aspects of noise.

Most other hazards are recognized and effectively guarded against. Direct protective measures are always best. Guards on machines prevent accidents. Mechanical loaders keep hands at safe distances. Dust collectors and ventilating systems remove irritating dusts and vapors. Devices, such as respirators, worn by operators are not as effective as direct measures, chiefly because of human carelessness and an innate desire to be free of encumbrances.

To protect workers from noise, ear plugs or wardens can be supplied. These wardens reduce noise intensity and even filter certain undesirable frequencies. As with other types of devices, a continuous educational program is necessary to protect the worker against himself.

It is far better to eliminate, reduce or isolate the sources of noise. Redesign of a mechanism to eliminate resonant frequencies, substitution of a squeeze or press for impact or hammer operations and use of vibration mountings to prevent sound transmission have effectively reduced problems in many plants. Also, remote controls and automatic operations keep the worker at safe distances.

Increasing attention is being devoted to solutions for this long overdue problem. At the recent ASME meeting, noise control and methods available for minimizing the hazard were discussed. Organizations such as Armour Research Foundation have conducted extensive tests on noise levels and how to effectively reduce them. The tool engineer, who has not made a study of his plant with a view toward eliminating noise, should do so without delay.

John W Greve
EDITOR

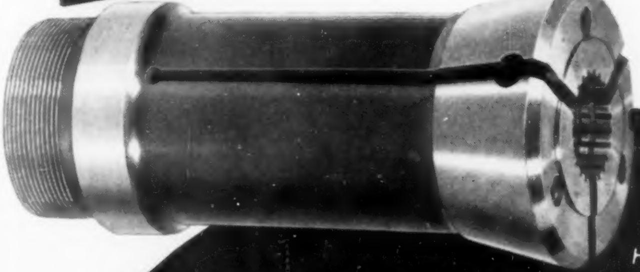
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-4

HARDINGE COLLETS and FEED FINGERS

for ACME-GRIDLEY Automatics*

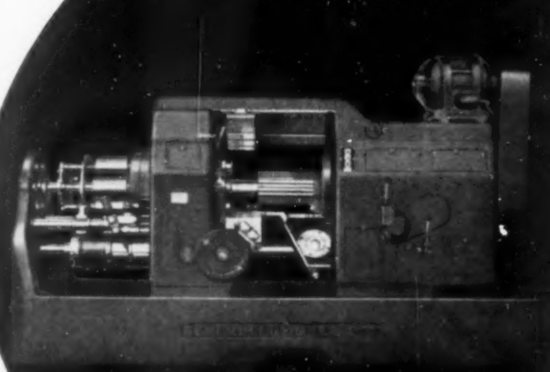
HARDINGE
ELMIRA, N.Y.

- **30% to 80% Lower Tooling Cost**
- **Higher Production Efficiency**



HARDINGE Style "S" Master Collet

HARDINGE Style "B" Master Feed Finger

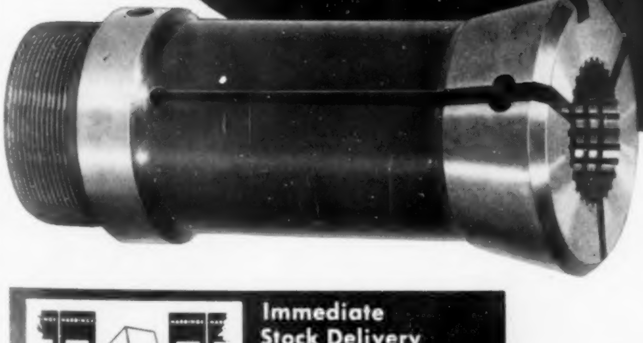


30% to 80% lower tooling costs result when using Hardinge Master Collets and Master Feed Fingers with low-cost replaceable pads.

Quick change-over because Master Collets remain in place while changing pads. Master Fingers remain in the feed tube—no wear on feed tube threads. Make Hardinge your one source of supply for all collets and feed fingers. You will have fewer work interruptions due to breakage, loss of tension, and scoring of stocks.

Hardinge brings you 62 years of engineering and manufacturing experience.

HARDINGE Regular Collet

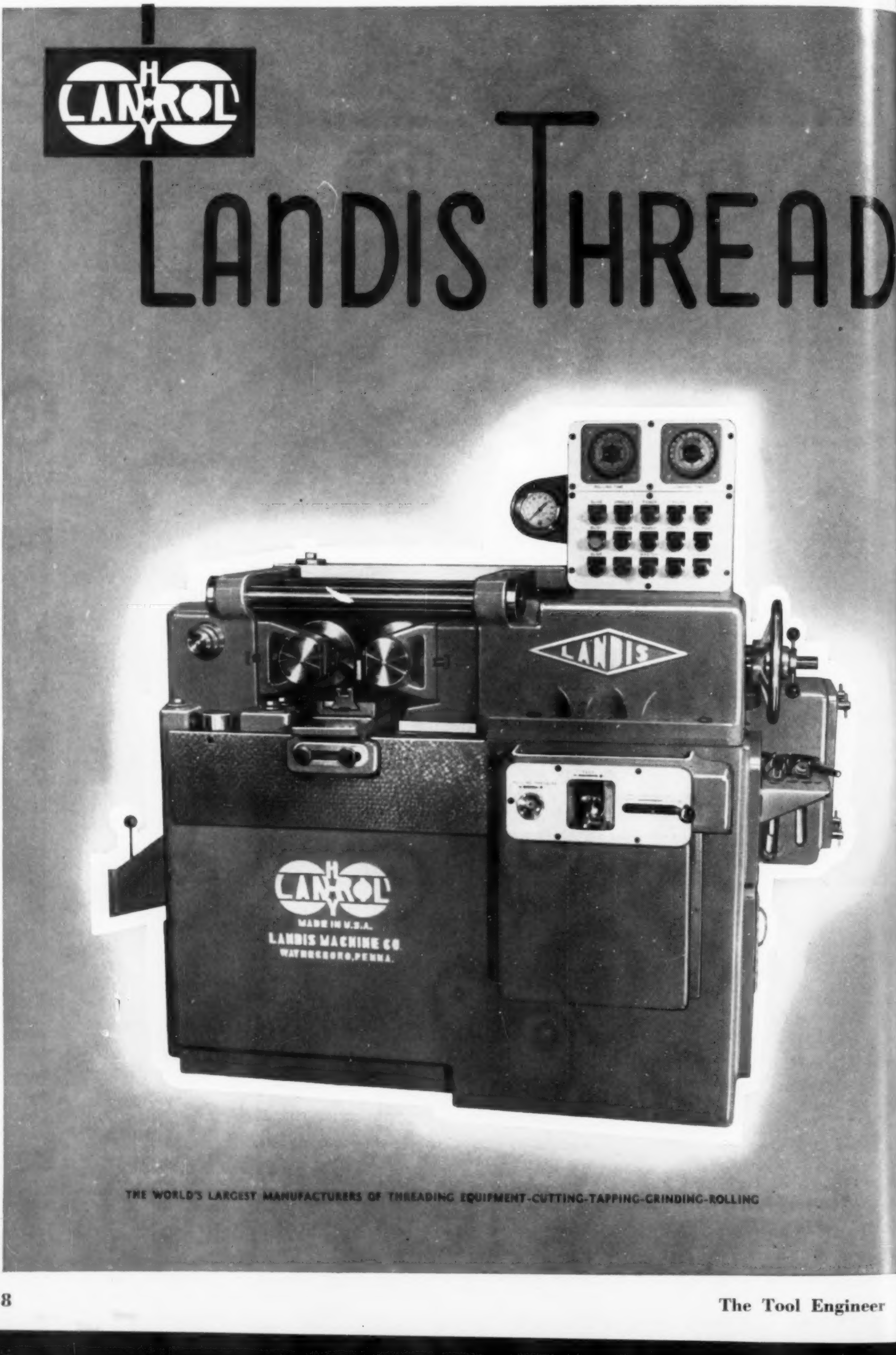


HARDINGE Regular Feed Finger

* Also available for the following automatics: Cone, New Britain, Greenlee, Gridley, National Acme.

Immediate Stock Delivery
from Hartford, New York, Philadelphia, Dayton, Chicago, Minneapolis, St. Louis, Detroit, San Francisco, Los Angeles, Elmira

**HARDINGE BROTHERS, INC.
ELMIRA, N. Y.**



LANDIS THREAD
LANDIS
MADE IN U.S.A.
LANDIS MACHINE CO.
WAYNESBORO, PENNA.
THE WORLD'S LARGEST MANUFACTURERS OF THREADING EQUIPMENT-CUTTING-TAPPING-GRINDING-ROLLING

ROLLING MACHINE

NOW *Available!*

LANDIS is now offering a revolutionary new machine for producing threads, not available anywhere else in the Western Hemisphere—the LANHYROL Thread Rolling Machine.

The LANHYROL produces strong, accurate threads of excellent finish by the chipless, cold-forming process—and offers unequalled output, flexibility, and range coverage:

* * * It will produce left- and right-hand threads of all types (except square), including UNC, UNF, Acme, worm, and many special forms.

* * * It will thread all diameters from 3/16" to 3".

* * * Threads are rolled by four distinct methods—Infeed, Thrufeed, Continuous, and Reciprocal. The rolling method used is determined by the length and type of thread and the design and hardness of the workpiece.

* * * Threads can be produced to Class 2 and 3 fit by Continuous Rolling, and to Class 4 fit by Infeed, Thrufeed, and Reciprocal Rolling.

* * * Production rates are high. They vary with the individual operation, but for example—600 pieces per hour, rolling ⅞" 9 pitch UNC threads 1¼" long on 4140 steel of 29C Rockwell hardness, using Infeed Rolling with semi-automatic operation and manual loading.

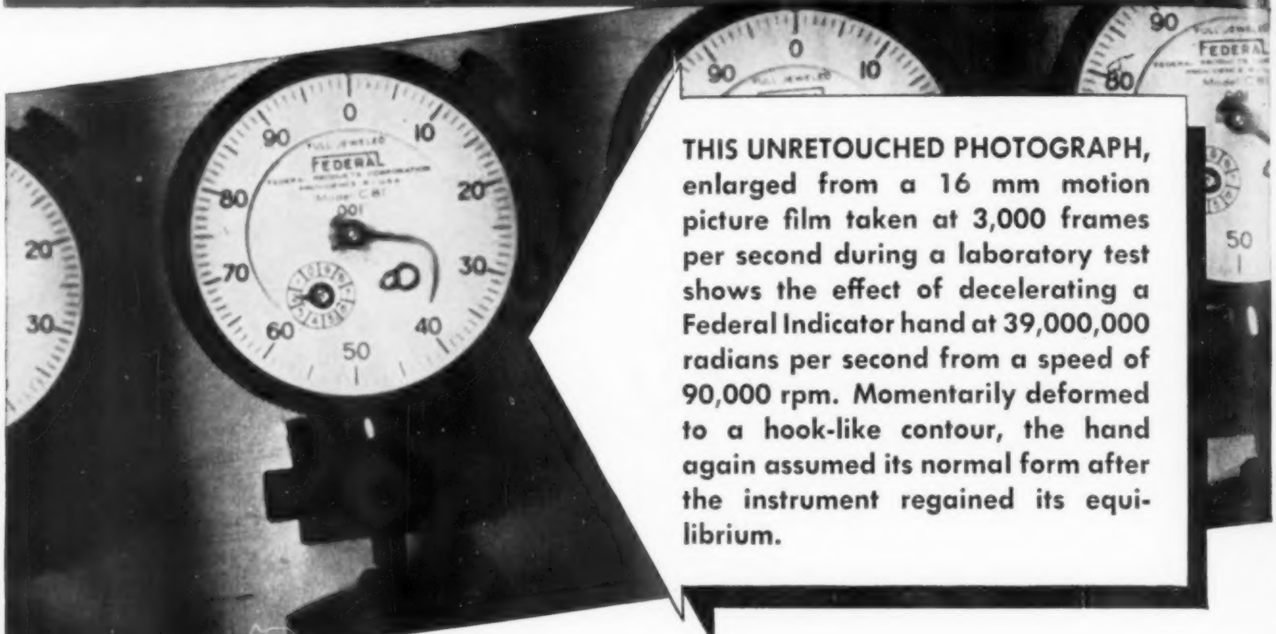
* * * Hopper equipment, automatic operation, and auxiliary equipment for special threads is available.

The LANHYROL Thread Rolling Machine is an important new addition to The Landis Line of Threading Equipment developed by more than 50 years of research and experiment. Additional information on request—please send specifications and ask for Bulletin *E-60.*

LANDIS *Machine* COMPANY

WAYNESBORO • PENNSYLVANIA • U. S. A.

What this test means to YOU!



PROBABLY YOU'VE NEVER STOPPED TO THINK HOW IMPORTANT AN INDICATOR HAND CAN BE...

IT IS NOT JUST CONVENTIONAL MODERN DESIGN that makes the hand on a Federal Dial Indicator look as it does!

This high-speed movie shows one of thousands of tests made in our laboratory in a constant effort TO PRODUCE THE FINEST POSSIBLE DIAL INDICATORS FOR YOU. In this destructive test the hand has been momentarily deformed by an excessive blow on the Indicator's contact point.

You naturally ask why we don't just make a stiffer hand. The answer is that a *heavier* hand would increase the inertia and friction within the Indicator and decrease its sensitivity and accuracy. A *lighter* hand would have less inertia but it would not recover its normal straightness after extreme operating conditions. The hand of a Federal Dial Indicator MAINTAINS ITS NORMAL SHAPE.

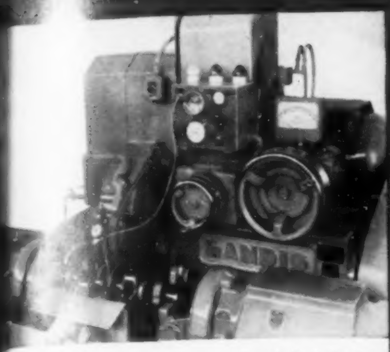
Furthermore, the hand on a Federal Dial Indicator IS STATICALLY BALANCED to assure a CONSISTENT GAGING PRESSURE against the workpiece. You get a more sensitive Indicator of GREATER REPETITIVE ACCURACY.

This kind of detailed research is typical of the great care that goes into the design and improvement of Federal Dial Indicators and helps to explain WHY FEDERAL IS THE WORLD'S LEADING MANUFACTURER OF DIAL INDICATORS.

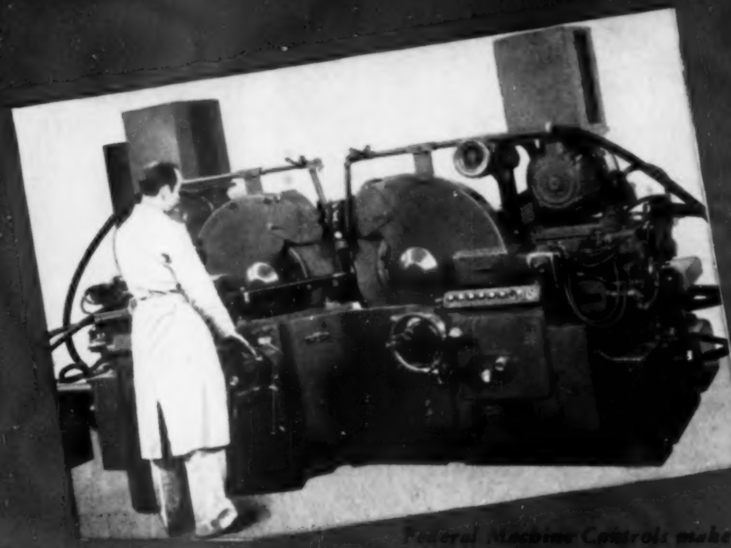
It is also very much worth noting that modern manufacturing techniques and Modern Quality Control have enabled us to sell Federal Dial Indicators AT THE SAME LOW PRICE FOR FIFTEEN YEARS. If you haven't our latest catalog showing the most complete line of Dial Indicators of all styles and sizes, write Federal Products Corporation, 5191 Eddy St., Providence 1, R. I.

FEDERAL

Largest manufacturer devoted exclusively to designing and manufacturing *all types* of DIMENSIONAL *INDICATING* GAGES



Grinding Main Journals on a Crankshaft is done quickly and without scrap with this Federal Air-Electric Grinding Gage. The operator loads the machine, snaps the caliper on the work and starts the machine cycle. When the work is down to size, the wheel automatically backs up. The large Air Dial and the three signal lights provide visual checks on the progress of the grinding. With this Machine Control Gage it is impossible to grind undersize scrap because the gage automatically backs the wheel up when work is to size.



Federal Machine Controls make the grinding of automotive rear axles practically automatic.

FEDERAL Automatic MACHINE CONTROL GAGES

This Federal unit, employing an Arnold continuous caliper type grinding gage, automatically controls the size of the journal surfaces of 1100 lb. freight car axles. The gage, ordinarily retracted to provide loading clearance, automatically springs onto the work and takes control of the grinding process at the start of the grinding cycle. Signal lights tell the operator when work is "over size", "near size", or "to size" and are connected electronically to the machine controls so the grinding cycle is automatically stopped when the required size is obtained. Tolerances are consistently maintained well within the plus 0.0005", minus 0.0000" specified.

have established their efficiency

AUTOMATION is a new term applied to an idea that general machinery manufacturers have been doing ever since Eli Whitney invented his Cotton Gin. But, controlling Machine Tools automatically so that they produce work to required sizes is comparatively new.

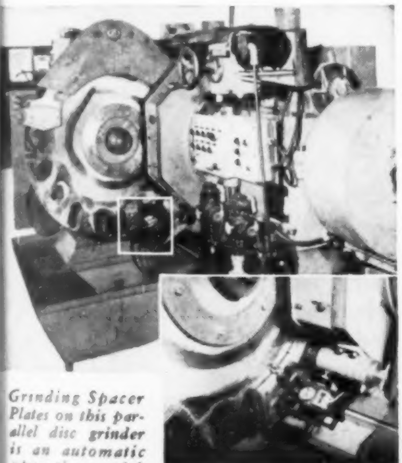
Federal, however, has been designing and building Gages for this purpose for several years. We offer this tried and proven experience to all builders and users of machinery where Automatic Dimensional Control of Machine Tools is desired. We can handle all phases of the work; from work-handling through gaging, machine control and disposal.

Federal is ready to provide standardized package units for air, electrical, electronic or combination controls and **will cooperate with your engineers to adapt these to your machine requirements.** Call —

FEDERAL PRODUCTS CORPORATION
5191 EDDY STREET • PROVIDENCE 1, RHODE ISLAND

SOME OF MANY POSSIBILITIES

- Percentage reject control. A simulation of automatic statistical Q.C.
- Automatic shut-off when dimension out-of-control.
- Automatic tool adjustment or compensation.
- Tool Adjustment Signalling.
- Automatic classification according to dimension.
- Automatic line operation signals, etc., etc.



Grinding Spacer Plates on this parallel disc grinder is an automatic operation with Federal Machine Control. Workpieces are loaded in the slotted carrier wheel and the gage controls the feed of the wheels to compensate for wheel wear. Corrections are made alternately to each wheel-head to maintain the centering of the carrier wheel. Automatic controls assure continuous production of good pieces, eliminating scrap.

A few of many applications

Ask **FEDERAL**

FOR ANYTHING IN MODERN GAGES...

For Inspecting, Measuring, Sorting or Automatically Controlling Dimensions on Machines

What do *you* think?

This standard 32-speed "AMERICAN" Hole Wizard Radial Drill head, in combination with a special drilling machine, has just completed the machining of 175,000 work pieces. The operations consisted of 6" diameter spot facing, drilling 5 holes ranging from 1.45" to 5" in diameter, step boring 3 holes ranging from 2.25" to 5" in diameter, two recessing operations and tapping 2.25" diameter holes.

In completing this job the tapping attachment frictions were engaged and disengaged well in excess of 1,000,000 times.

This entire operation was completed without one minute's down time and without maintenance or repair.

Although we have no data to substantiate this, we believe this *must* be some sort of a performance record.

What do **you** think? . . .

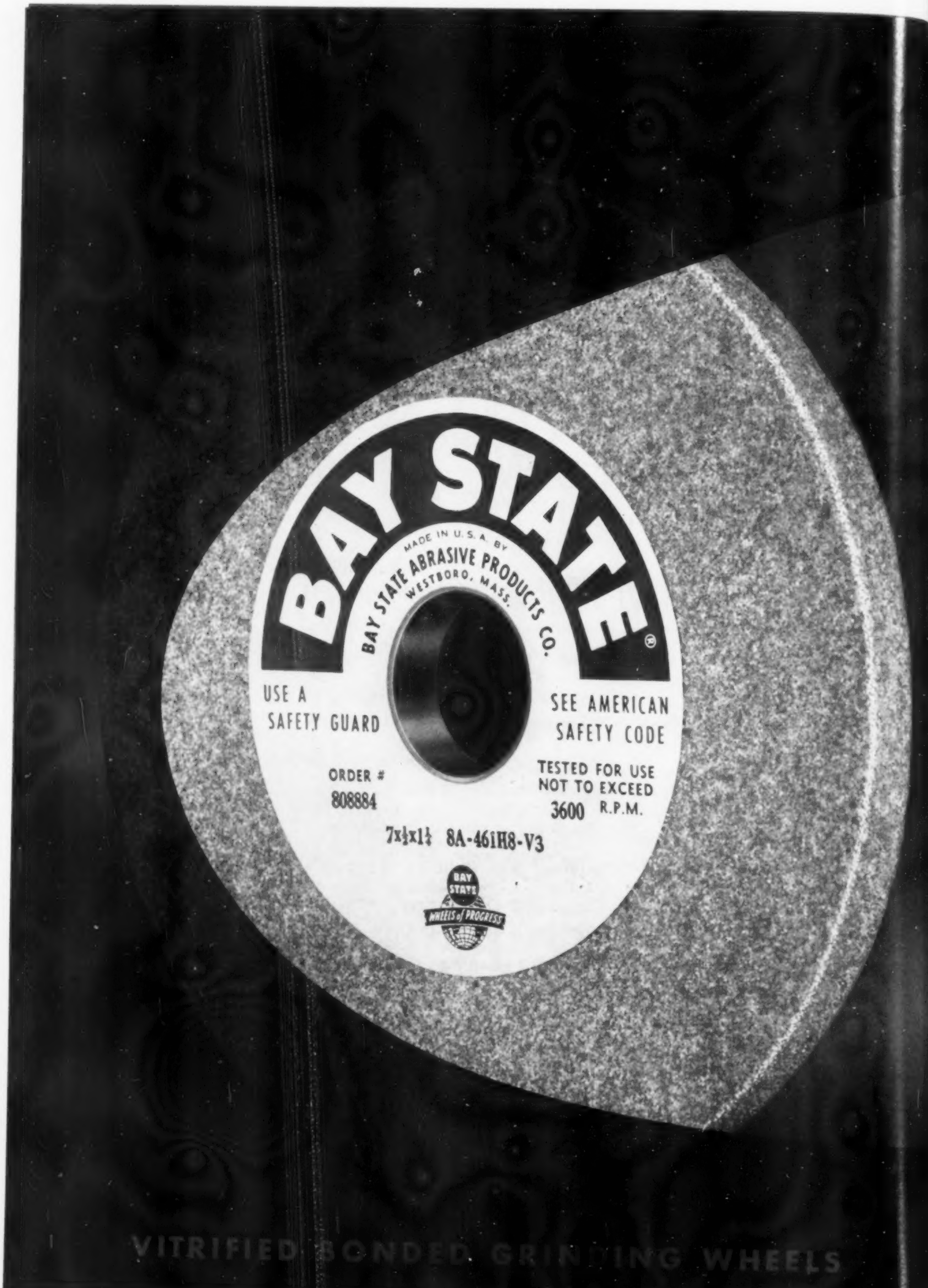
This is exactly the same type of head you get when you install a 32-speed "AMERICAN" Hole Wizard. What better guarantee of service could one ask than this performance record? This is the kind of service that has built "AMERICAN" prestige and preference and accounts for its worldwide reputation for top quality.

The many reasons contributing to "AMERICAN" Hole Wizard predominance are clearly illustrated and described by bulletin No. 327. May we send you one?

THE AMERICAN TOOL WORKS CO. **Cincinnati 2, Ohio, U. S. A.**

LATHES · RADIAL DRILLS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-13



BAY STATE
MADE IN U.S.A. BY
BAY STATE ABRASIVE PRODUCTS CO.
WESTBORO, MASS.
USE A SAFETY GUARD
SEE AMERICAN SAFETY CODE
ORDER #
808884
TESTED FOR USE NOT TO EXCEED
3600 R.P.M.
BAY STATE
WHEELS of PROGRESS
VITRIFIED BONDED GRINDING WHEELS

Available...

TWO EXTRA OPPORTUNITIES!

For each single hardness grade standard in the industry for precision grinding, BAY STATE makes *three* grade divisions. These "Fractional Grades" provide you with two *extra* opportunities to get a closer "fit" of vitrified bonded wheels for your grinding operations.

This extra refinement is standard at BAY STATE. Such close control, developed through advanced manufacturing techniques, means that BAY STATE does a *better* job of duplicating successful wheel specifications.

For improved precision grinding, get the *extra* benefits of "Fractional Grades" . . . with BAY STATE "WHEELS OF PROGRESS".

HERE'S PROGRESS IN GRINDING

(a) FRACTIONAL GRADES (b)

The three wheels above vary only in hardness. The middle one, with the figure 2 marked by the arrow, has an exact hardness of grade H. It is flanked by the two *extra* grade divisions you can get from BAY STATE:

(a) 1 means 1/3 *softer* in grade H.
(b) 3 means 1/3 *harder* in grade H.

Such extra, *standard* specifications mean progress in grinding for you . . . from BAY STATE.

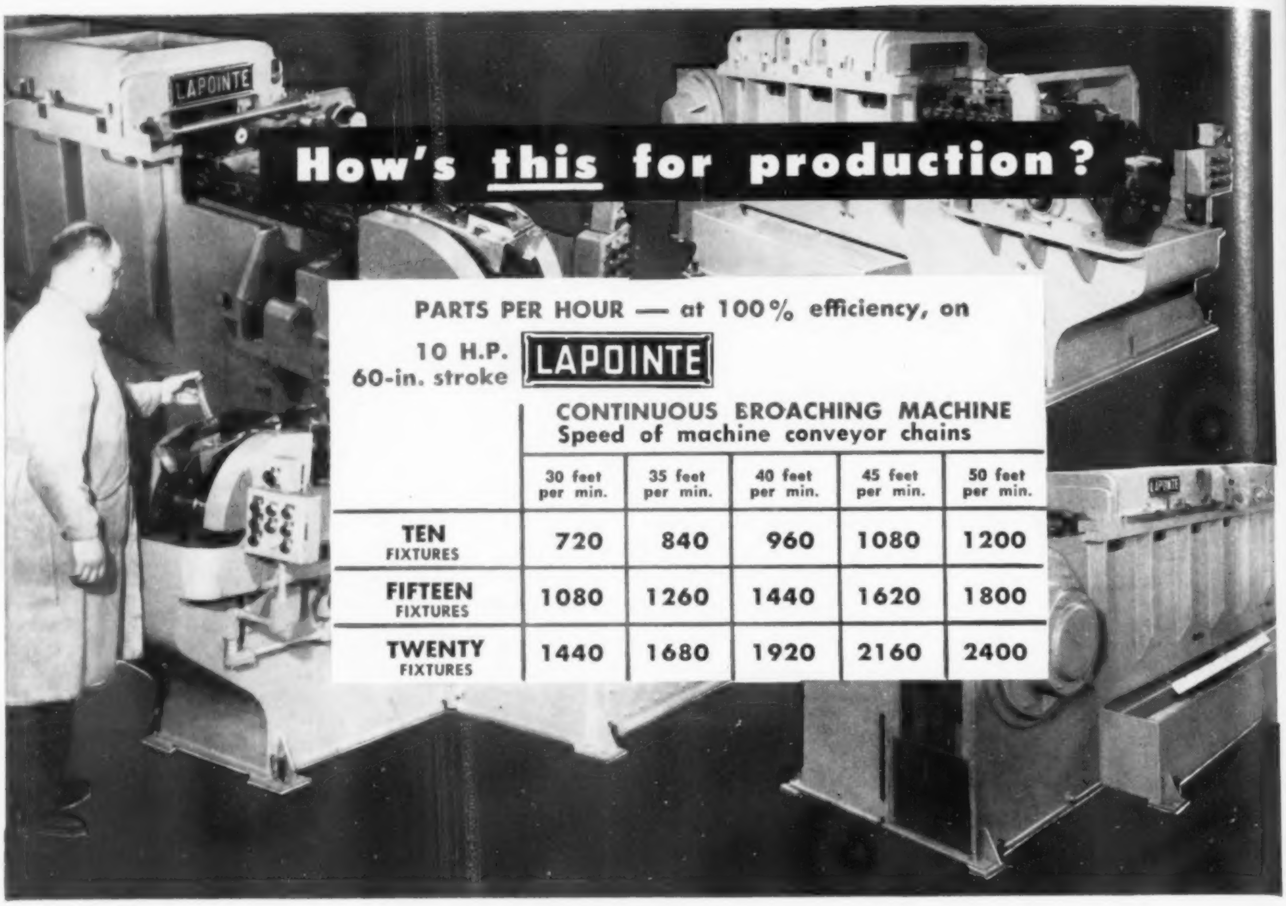
BAY STATE ®

WHEELS of PROGRESS

GRINDING WHEEL INSTITUTE MEMBER

BAY STATE ABRASIVE PRODUCTS CO., Westboro, Massachusetts, U. S. A.

Branch Offices and Warehouses — Chicago, Cleveland, Detroit, Pittsburgh
Distributors — All principal cities
In Canada: Bay State Abrasive Products Co. (Canada) Ltd., Brantford, Ont.



How's this for production?

PARTS PER HOUR — at 100% efficiency, on 10 H.P. 60-in. stroke LAPOINTE CONTINUOUS BROACHING MACHINE

	Speed of machine conveyor chains: 30 feet per min.	35 feet per min.	40 feet per min.	45 feet per min.	50 feet per min.
TEN FIXTURES	720	840	960	1080	1200
FIFTEEN FIXTURES	1080	1260	1440	1620	1800
TWENTY FIXTURES	1440	1680	1920	2160	2400

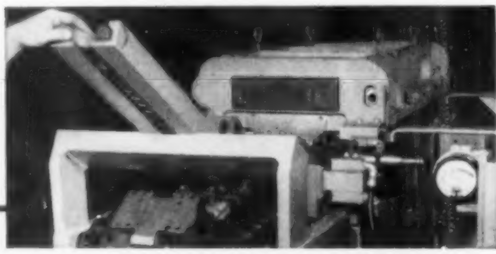
for **CONTINUOUS** MASS-PRODUCTION **BROACHING** of contour and flat surfaces, to precision tolerances

the production figures are FANTASTIC

LAPOINTE CONTINUOUS BROACHING

(. . . with the machine that doesn't stop!)

The machine runs **all the time**, has a foolproof self-unloading feature, and delivers precision results at amazingly reduced costs! Every plant that is now mass-producing parts **by any machining process** should investigate the Lapointe Continuous Broaching Machine for money-saving advantages. Send for descriptive **Bulletin** CH-5.



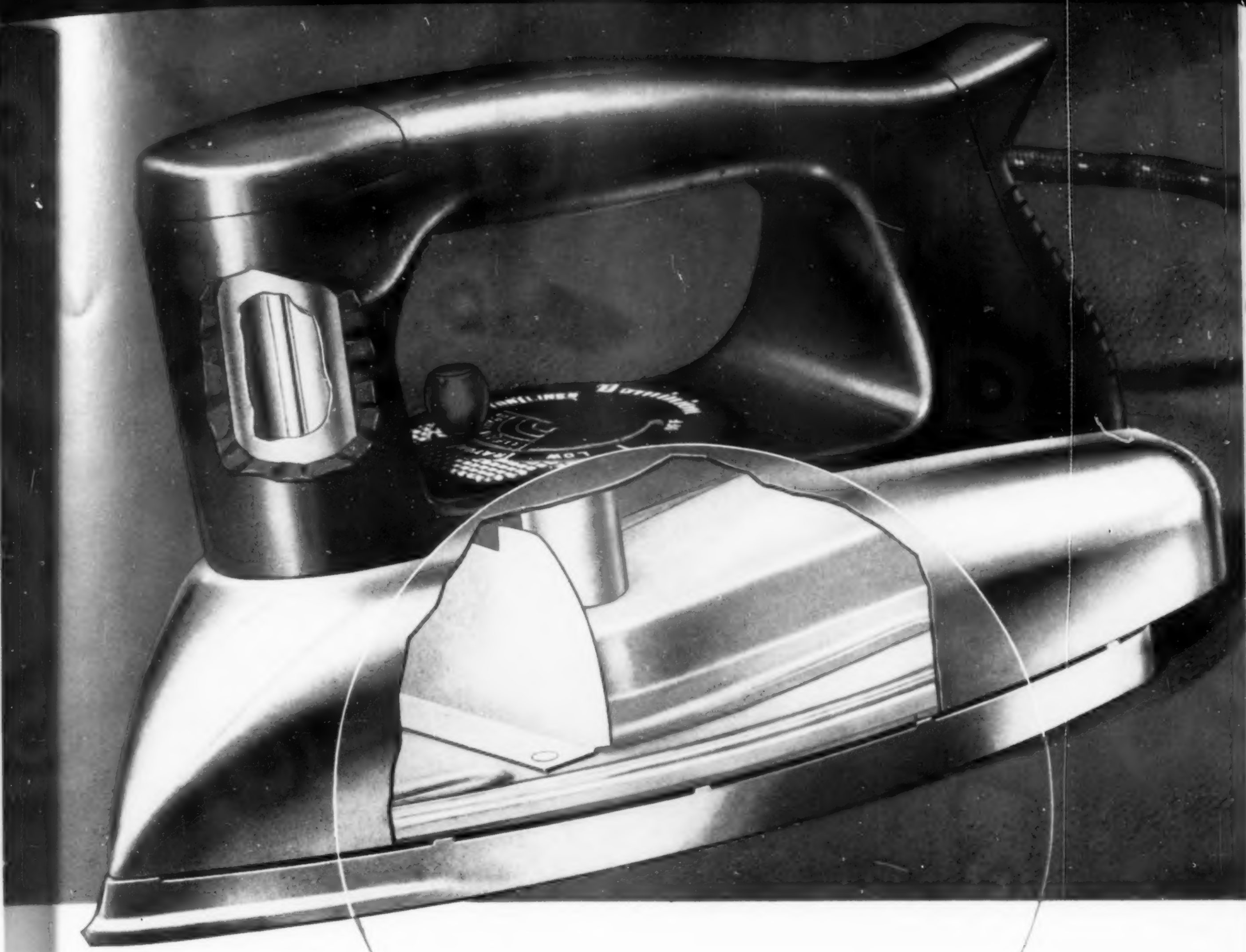
Hopper feed . . . for FULL AUTOMATION!
Substantial increase in production is possible with automatic loading. Wherever practical to use, Lapointe engineers always design the machine for hopper feed.

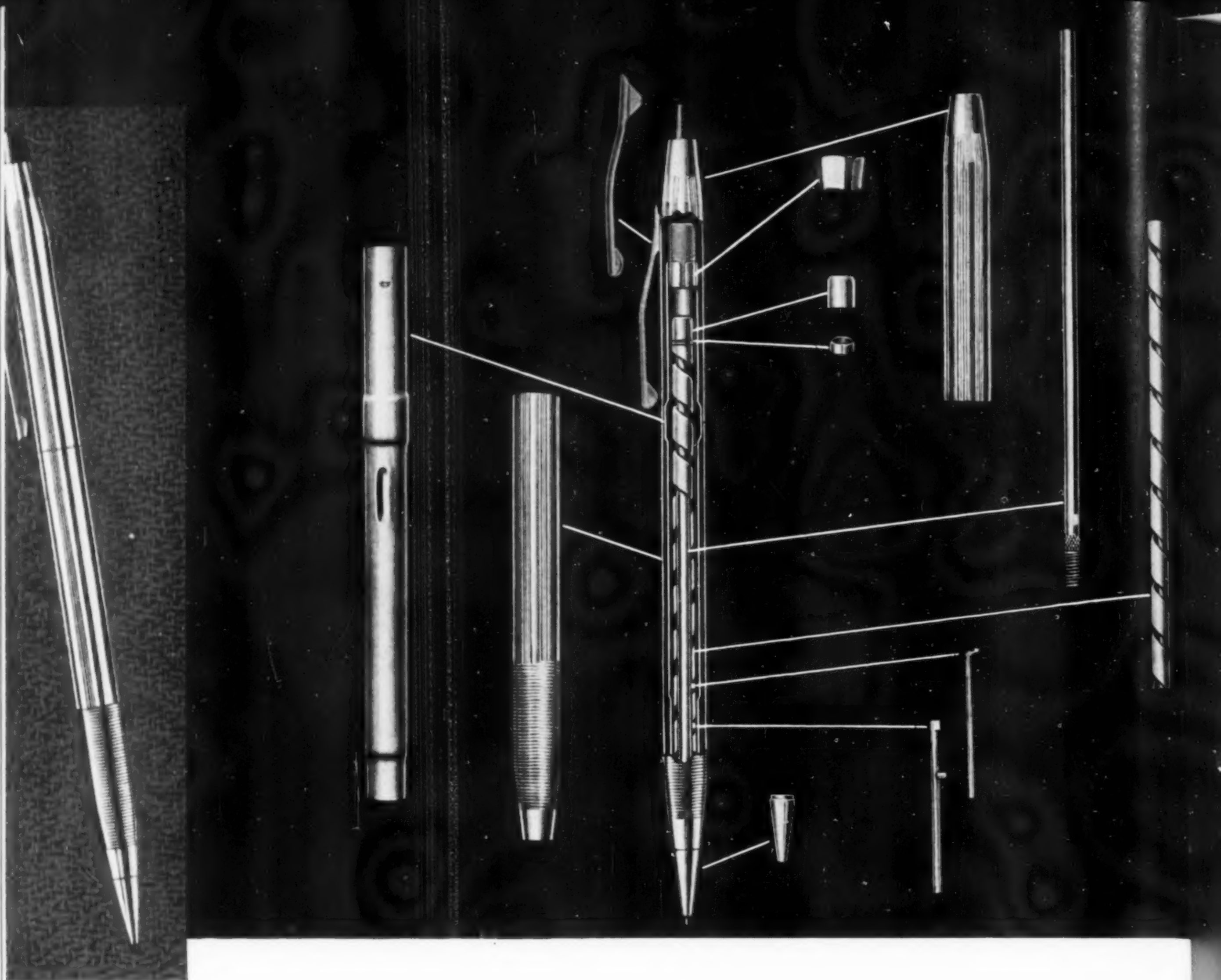
LAPOINTE BUILDS THE MACHINE
BUILDS THE FIXTURES
AND MAKES THE TOOLS

Lapointe takes _all_ the responsibility for your CONTINUOUS BROACHING program!

THE LAPOINTE MACHINE TOOL COMPANY
HUDSON, MASSACHUSETTS • U.S.A.
In England: Watford, Hertfordshire

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES





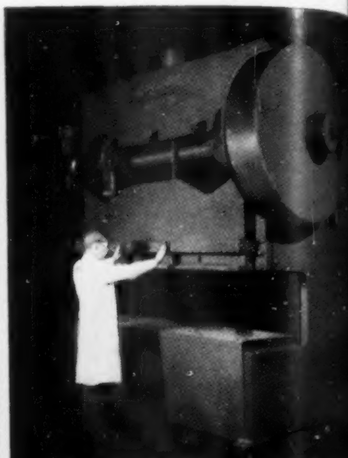

THE PERFECTLY BALANCED TOOL
R and L TURNING TOOL
Replaces an assortment of fourteen different tools . . . changes from right to left in ten seconds . . . no misalignment . . . extremely fine adjustment provided . . . for rough and heavy cuts as well as finishing cuts . . . The R and L TURNING TOOL is constructed with best possible care and of finest steel.
Write for Catalog
RIGHT R and LEFT L TOOLS
1825 BRISTOL STREET • PHILADELPHIA 40, PA.
TURNING TOOL • CARBIDE OR ROLLER BACKRESTS • RELEASING OR NON-RELEASING TAP AND DIE HOLDERS, (ALSO FURNISHED FOR ACORN DIES) • UNIVERSAL TOOL POST • TURRET BACKREST HOLDER • CUT-OFF BLADE HOLDER • RECESSING TOOL • REVOLVING STOCK STOP • FLOATING DRILL HOLDER • KNURLING TOOL

In plate or sheet metalworking . . .

NIAGARA MACHINES CAN

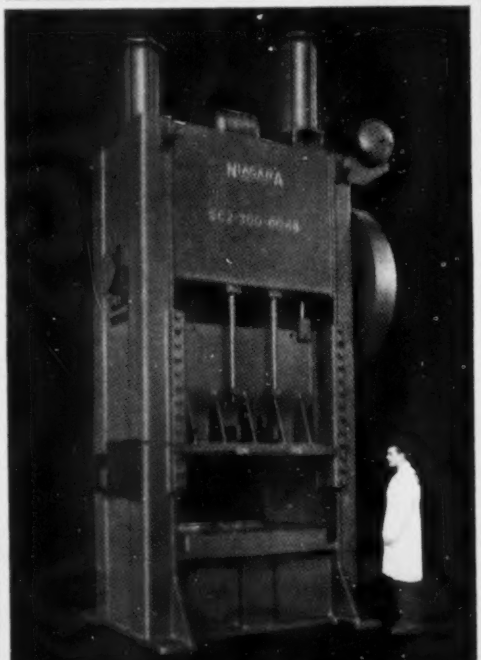
PRESS BRAKES
50 - 775 ton capacities.

COMBINATION CIRCLE SHEARS AND FLANGES
High speed machines handling a wide range of medium to heavy work.

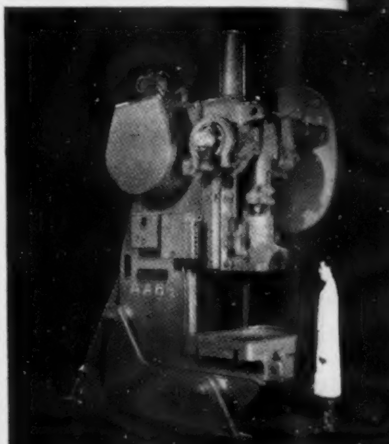


GAP FRAME DOUBLE CRANK PRESS
3 - 6½ inch shaft diameters.
48 - 222 ton capacities. Also, inclinable

BENDING ROLLS
Hand and power driven for a wide range of lengths and thicknesses.



STRAIGHT SIDE DOUBLE CRANK PRESSES
50 - 300 ton capacities.



SINGLE CRANK OPEN BACK INCLINABLE
1¼ - 7½ inch shaft diameters.
7 - 250 ton capacities.

NIAGARA

America's most complete line of presses, shears, machines and

DRUM MAKING EQUIPMENT

ELECTRONIC AUTOMATIC WELDER

FOLDER — BRAKES
- Adjustable Bar Folders
- Universal Folders and Brakes

GROOVERS and SEAMERS

HAND or FOOT OPERATED SHEARS
- Circle Shears
- Foot Curved Shears
- Foot Gap Shears
- Foot Squaring Shears
- Ring Shears
- Rotary Slitting Shears

HAND TOOLS
- Bench Plates
- Bench Shears
- Hammers
- Hand Groovers
- Hollow Punches
- Rivet Sets
- Snips
- Stakes

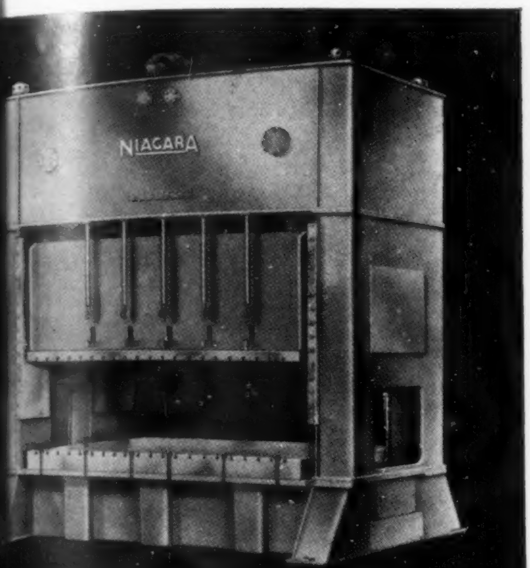
LEVER SHEARS and PUNCHES
- Bar and Rod Cutters
- Combination Lever Punches and Shears
- Lever Punches
- Lever Shears
- Notchers

POWER PRESSES
- Bench Presses
- Foot Presses
- Gap Frame Double Crank Presses
- Gap Frame Single Crank Presses
- Horn Presses — Side Seamers
- Hydraulic Presses
- Inclinable Gap Frame Double Crank Presses
- Inclinable Presses
- Straight Side Double Crank Presses
- Straight Side Eccentric Geared Presses
- Straight Side Single Crank Presses

POWER PRESS BRAKES

POWER SQUARING SHEARS
- Economy Line Power Squaring Shears (14 Gage Max.)
- Gap Frame Overdrive Power Squaring Shears
- Light Gage High Speed Power Squaring Shears
- Underdrive Precision Type Heavy Duty Power Shears

DO THE MOST FOR YOU



STRAIGHT SIDE ECCENTRIC GEARED PRESSES
One, two and four-point suspension.
100 - 1000 ton capacities.

UNDERDRIVE POWER SQUARING SHEARS
Shim stock to 1 inch capacities in lengths from 3 - 20 feet.

✻ MOST EXTENSIVE LINE:

From giant, power-operated machinery to small hand tools

✻ MOST ADVANCED DESIGNS:

Years ahead in performance through forward-thinking engineering

In the world's largest automotive and appliance plants or the smallest of sheet metal shops, Niagara machines and tools are usually at work "in force."

Batteries of giant presses are teamed up with speedy ring and circle shears. Massive, rugged press brakes stand side-by-side with powerful bending rolls and squaring shears. Versatile lever punches, rotary machines, groovers and seamers . . . all operate together to produce a better product at lower cost. The Niagara lines are "companion lines" of metalworking machines and tools that work together. A Niagara-equipped shop or plant is years ahead in quality and volume of production.

Whatever you require — power presses or hand tools — Niagara is the line that can do the most for you. It is the most complete in the industry . . . the most advanced in engineering. You can consult a Niagara representative with complete confidence of unbiased recommendations. Niagara has the right machines and tools for your requirements.

Tools for plate and sheet metal work

POWER ROTARY SHEARS
- Power Circle Shears
- Power Circle Shears and Flangers
- Power Ring and Circle Shears

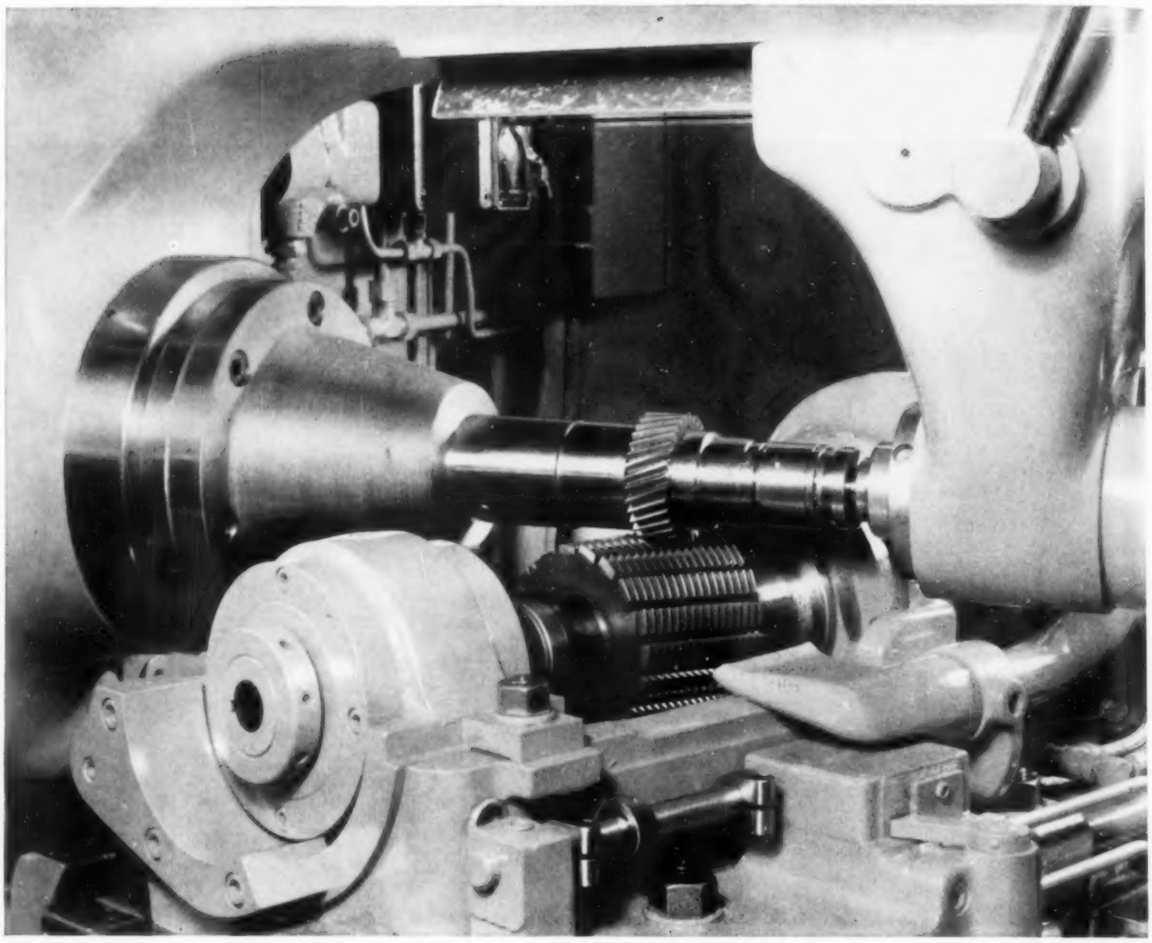
ROTARY MACHINES
- Bending
- Burring
- Combination Machines
- Corrugating
- Crimping
- Edging
- Flanging
- Forming and Curving Machines
- Multi-Drive Table for Rotary Machines
- Setting Down Machines
- Turning
- Wiring

SLIP ROLL FORMERS
- Hand and Power Machines

BRING YOUR FILES UP-TO-DATE WITH INFORMATIVE NIAGARA BULLETINS

Listed at the left are the diversified machines and tools that make up the famous Niagara line. Be sure that you have the latest data on the ones that apply to your type of work. At your request, specific Niagara Bulletins will be mailed promptly, without obligating you.

NIAGARA MACHINE & TOOL WORKS • BUFFALO 11, N. Y.
DISTRICT OFFICES:
Buffalo • Cleveland • Detroit • New York • Philadelphia
Dealers in principal U. S. cities and major foreign countries



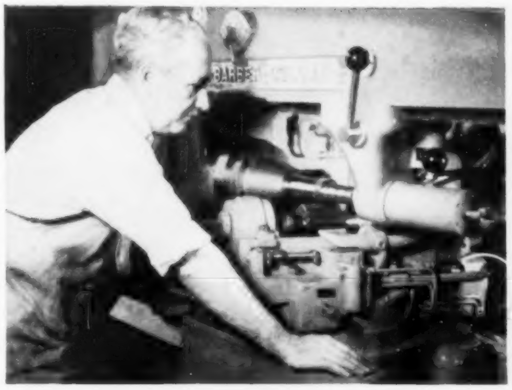
HIGH-SPEED HOBBING

INCREASES PRODUCTION AND TOOL LIFE

The Barber-Colman No. 14-15 Hydraulic Hobbing Machine is being used in several plants for hobbing of steel gears at speeds of approximately 300 SFM with an increase in both production and tool life. Although these speeds have not been considered practical until recently, the size, power and rigidity of the No. 14-15 Machine make it ideal for high-speed hobbing. Even with a standard hob slide, speeds of 300 SFM with a 5″ hob are possible. However, most machines for high-speed hobbing are equipped with a special heavy-duty, high-speed hob swivel.

The high-speed hob swivel is capable of speeds up to 950 RPM and is designed to accommodate hobs up to 7″ diameter. The extra size and weight of this swivel provide the rigidity to maintain accuracy at high speeds. It is equipped with super-precision ball or tapered roller bearings. An automatic hob shifter may be furnished as extra equipment. High-speed hob swivels may be installed on recent machines in the field.

B U I L D E R S O F P R E C I S I O N G E A R



The jobs shown here indicate at least 200% increase in production, 100% better tool life, greater profile accuracy and equal or improved surface finish on the hobbed gears, hobbing at speeds of 300 SFM or greater. Using ground and unground hobs, gears were cut from a wide range of steels as high as 207 Br. hardness.

FIRST SERIES OF TESTS

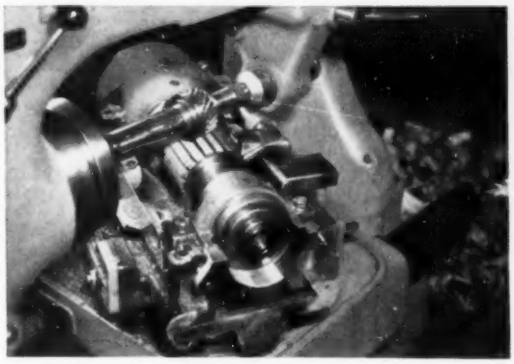
GEAR		STANDARD HOB SWIVEL		HIGH-SPEED HOB SWIVEL		% INCREASE	
DP	No. Teeth	Cutting Time at 135 SFM	Pieces Per Shift	Cutting Time at 326 SFM	Pieces Per Shift	Prod.	Tool Life
6	36 Spur	10.64 min.	72	4.2 min.	161	253%	223%
6	35 Spur	11.62 min.	72	4.5 min.	151	258%	209%
8	55 Helical	15.14 min.	50	6.94 min.	105	218%	210%
8	62 Helical	26.8 min.	28	10.3 min.	72	260%	257%

Double Thread Hob, 5x5x2 — Feed — .060"/rev.
Steel — AISI 8620 normalized — No difference in surface quality
Profile and lead angle above average accuracy

SECOND SERIES OF TESTS

HOB	GEAR	SPEED	FEED
Accurate Unground 9 D.P. 3-Thd. 5x5x2	22 Teeth, Helical SAE 5135 170-207 BHN	307 SFM	.045"/rev.
Same	Same	307 SFM	.070"/rev.

Climb Hobbing
Material — AISI 5135
Average lead error—at .070" feed within .0006" in 13/16"
Total Composite Error—.002" both feeds
Estimated Hob Life—200 per sharpening
Using same speed and feeds with conventional hobbing, resulting finish was not as good.



Although high-speed hobbing of steel gears is not used extensively as yet, it is used on enough jobs to prove that it is applicable under the proper conditions. Tests indicate that tool life increases until a speed of 200 SFM is reached, and then drops off rapidly to a speed of 250 SFM. After 250 SFM, however, hob life increases again until it is equivalent or better at 300 SFM than at 200 SFM. Materials on which satisfactory results have been produced include AISI 1113, 8620, 5135 and 4140.

Our Engineers have been working with our customers on high-speed hobbing and have helped to solve many problems. They will be glad to discuss the economy of high-speed hobbing to your specific job if you will submit your part print and production requirements to them.

Call your Barber-Colman representative or write direct to:

HOBS • CUTTERS • REAMERS
HOBBING MACHINES
HOB SHARPENING MACHINES

BARBER COLMAN

Barber-Colman Company

GENERAL OFFICES AND PLANT, 631 ROCK STREET, ROCKFORD, ILLINOIS

HOBS AND MACHINES SINCE 1911

How should I buy machine tools?

Outright purchase?

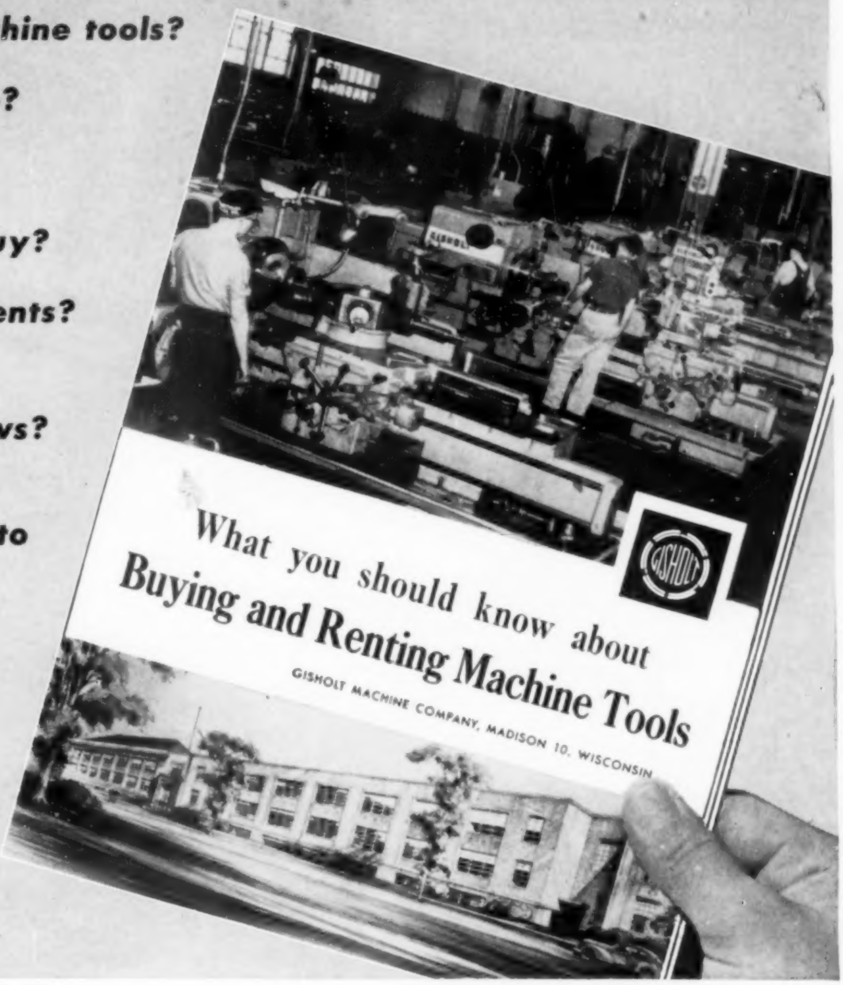
Should I Lease?

Lease with option to buy?

Buy on extended payments?

What about the new tax laws?

How can I know when to replace machines?



This New Gisholt Bulletin Will Help You

Recently, a lot of things have been happening which tend to confuse the outlook for buyers of machine tools and other industrial equipment. So Gisholt prepared this booklet to deal with the most important of them. The aim is to help you find the wisest answers in your particular case.

The booklet discusses leasing and time payment plans, makes cost comparisons, discusses depreciation under the new tax codes, replacement programs and the MAPI formula for machine replacement. A copy of this booklet is yours for the asking. No obligation, of course. Use the coupon.

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

The Gisholt Round Table represents the collective experience of specialists in the machining, surface finishing and balancing of round or partly round parts. Your problems are welcome here.

TURRET LATHES • AUTOMATIC LATHES
SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

Gisholt Machine Company
Madison 10, Wisconsin
1227 E. Washington Ave.

Gentlemen:

☐ Please send me a copy of your new booklet on extended-payment and leasing plans.

☐ Please have a Gisholt representative call on me.

Name............................ *Title*...................

Company name..

Street address..

City........................ *Zone*...... *State*............

Yes, from the Brooklyn Bridge to the Golden Gate, your only source for time-saving, money-saving Morse *Electrolized* Drills, Taps, Reamers, Cutters and End Mills is your nearest Morse-Franchised Distributor.

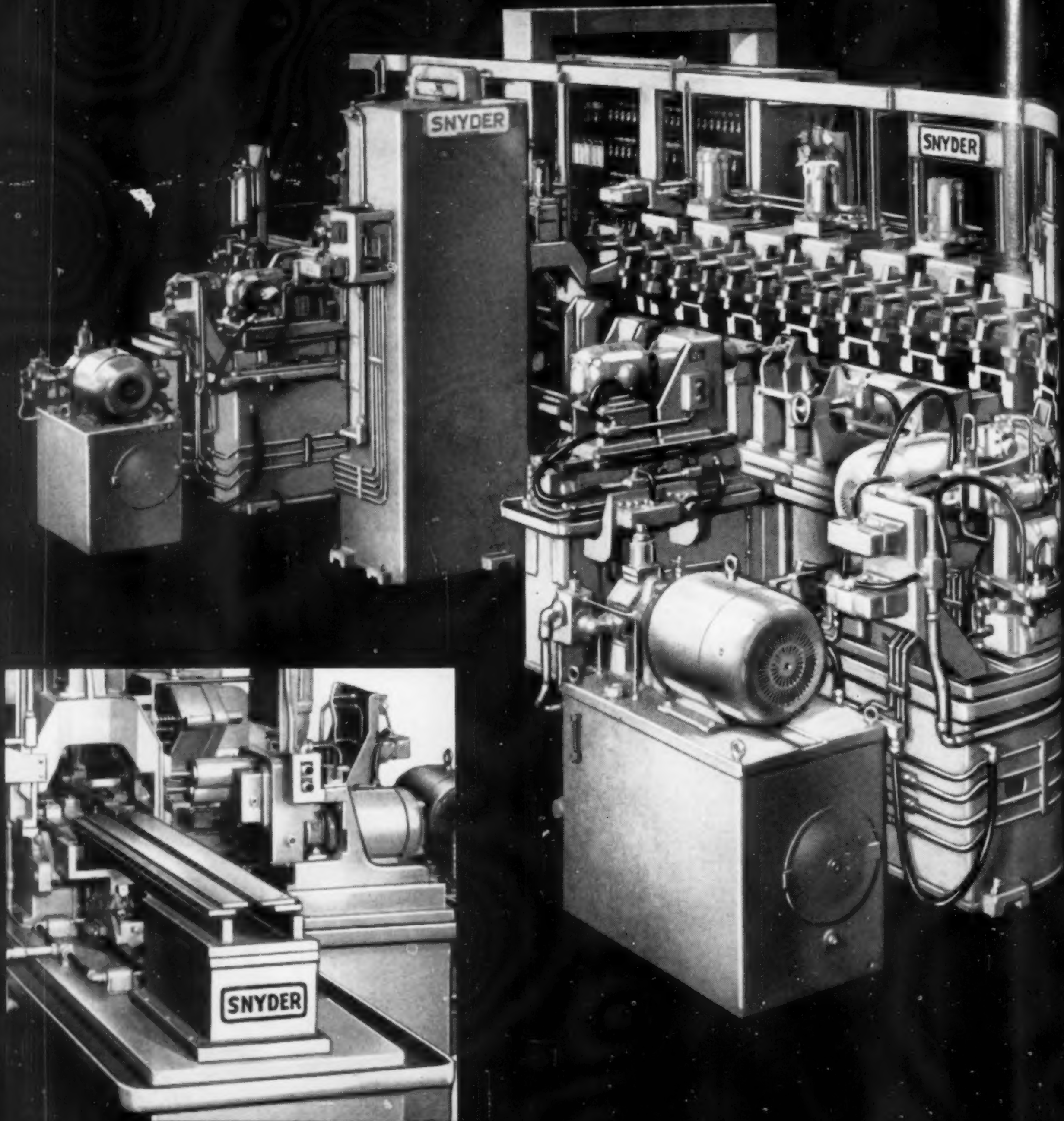
Certified test-reports prove that . . . on jobs where there's excessive wear and abrasion . . . *Morse Electrolized Tools last 2 to 10 times longer than untreated tools.*

And that's why, on any tough job you have now . . . or on *any* job, tough or not, where you can profit by this extra tool life and performance . . . it pays to consult your Morse-Franchised Distributor on the application of Morse *Electrolized* Tools to your own particular needs. He has the practical knowledge . . . and he's backed by the top line and the top engineering service of the cutting tool industry.

MORSE TWIST DRILL & MACHINE COMPANY
NEW BEDFORD, MASSACHUSETTS
(Division of VAN NORMAN CO.)
Warehouses in New York, Chicago, Detroit, Dallas, San Francisco

MORSE

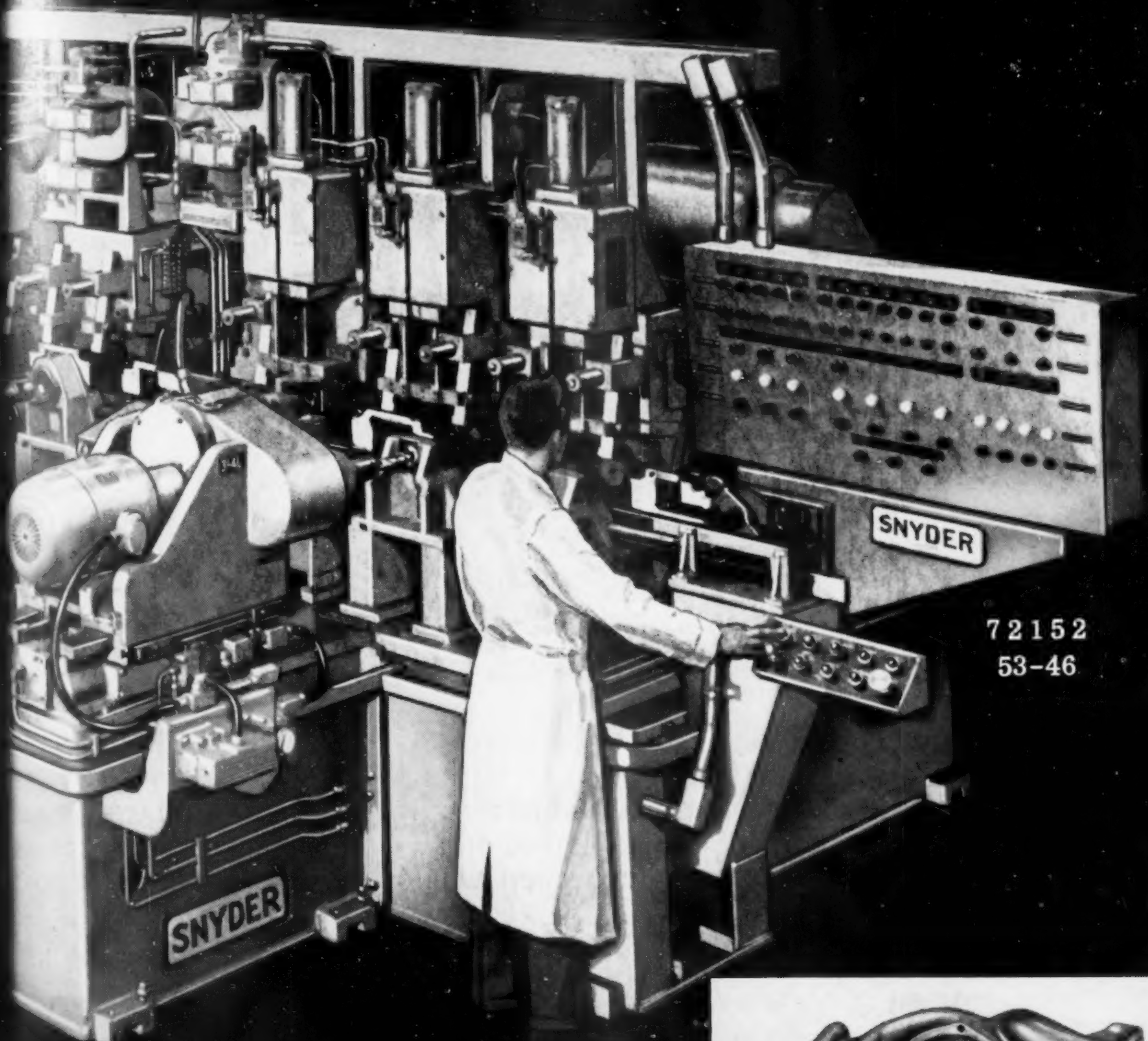

MORSE
Morse Exclusive
TO COAST
Cutting Tools
Buy them by phone from your
Morse-Franchised Distributor
and save ordering time

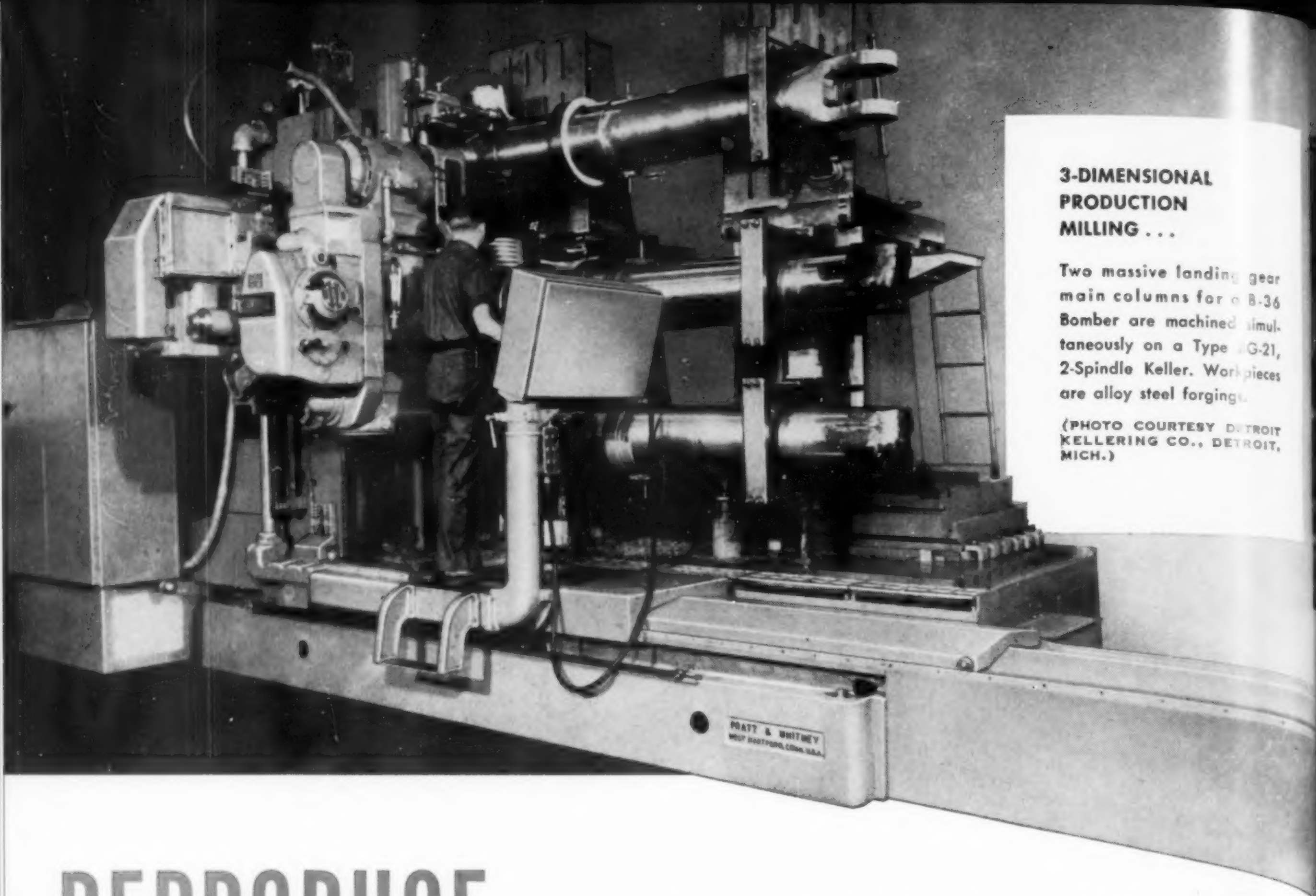


This is the discharge end of the machine. The part, which is originally in vertical position, is laid horizontally and swung 90° to expose all sides to the tools.

SNYDER SPECIAL automatic

24-station transfer machine for processing automotive water pump housings; drills, mills, faces, chamfers, taps all holes and probes tap drill holes. Production, 81 pieces an hour at 80% efficiency.


SNYDER
SNYDER
72152
53-46



3-DIMENSIONAL PRODUCTION MILLING . . .

Two massive landing gear main columns for a B-36 Bomber are machined simultaneously on a Type BG-21, 2-Spindle Keller. Work pieces are alloy steel forgings.

(PHOTO COURTESY DETROIT KELLERING CO., DETROIT, MICH.)

REPRODUCE COMPLEX, IRREGULAR SHAPES

METAL FORMING AND DRAWING DIES • FORGING DIES • PLASTIC MOLDS
RUBBER MOLDS • DIE CASTING DIES • METAL PATTERNS • CAMS
PROTOTYPE WORK • PRODUCTION MILLING • AND MANY OTHER JOBS

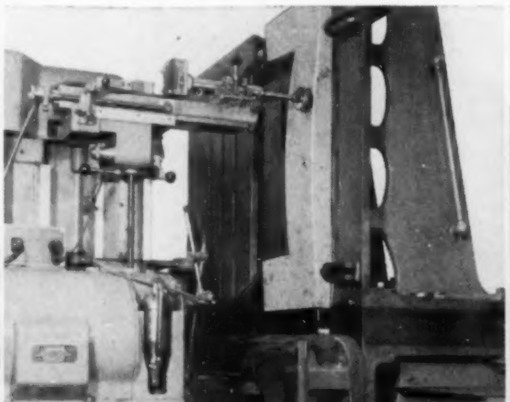
MODERNIZE *with* PRATT & WHITNEY REPLACE FOR PROFIT

faster and more economically

DIE CASTING DIE . . .

to produce metal shrouds for 25 hp outboard motors. Cavity was deep, intricate, and involved heavy metal removal. Cavity was completely Kellered in only 219 hours on a BG-21 Keller.

(PHOTO COURTESY ATOLS TOOL AND MOLD CORPORATION, CHICAGO, ILLINOIS)



DRAW DIE . . .

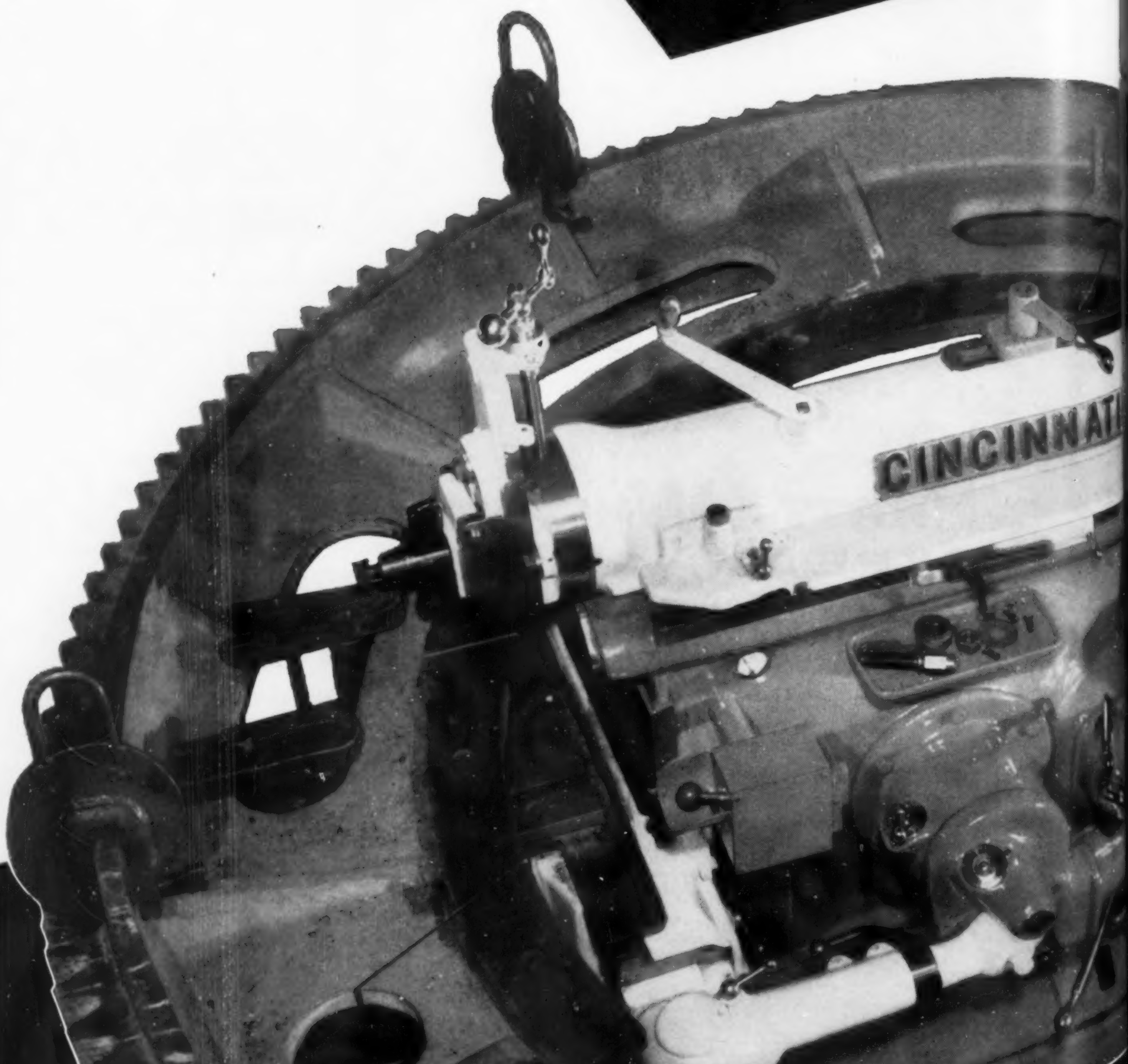
for a motor truck cab door, approximately 48" x 70". The complete job was produced quickly and economically on a Pratt & Whitney Type BG-21 Keller Machine.

(PHOTO COURTESY BUFFALO TOOL & DIE MFG. CO., BUFFALO, N.Y.)

PROFILE MILLING . . .

an aluminum aircraft wing spar is fast and easy with "Kellering." The only template usually required for this type of work is a simple, 2-dimensional template.

the UNUSUAL



is NORMAL for CINCINNATI SHAPERS

Stress relieving this massive gear required unusual rigidity of table and cross slide, and accurate starting and stopping of the shaper.

Some money making Cincinnati features:

- Electro-Magnetic Clutch and Brake.
- 50 P.S.I. automatic lubrication.
- Full control of all machine functions at operator's position.
- Solid, extended ram ways and many other features.

Write for Catalog N-6.

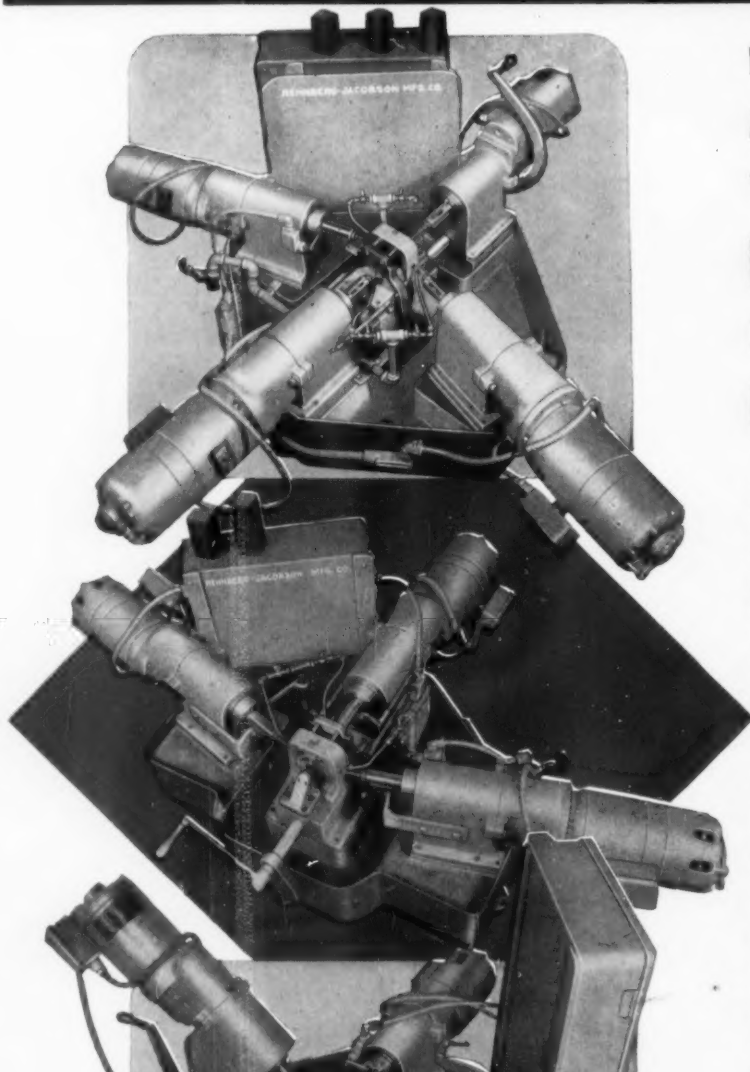
Photos courtesy Couer d'Alene Hardware & Foundry Company, Wallace, Idaho.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A. SHAPERS • SHEARS • BRAKES

CINCINNATI

Rehnberg-Jacobson



THERE ARE MANY WAYS YOU CAN USE REHNBERG DRILL AND TAP UNITS...

Among the problems that will face you and other manufacturers in the immediate future is the question of how far to go in considering the use of automatic and semi-automatic machinery in order to combine a multiplicity of standard operations. *We would like to work with you in the resolution of that question,* because we feel we can offer some ideas that will be mutually advantageous, particularly in the design and manufacture of simple, clever, and effective production machinery.

THESE MACHINES SHOW INTERESTING ANGLES

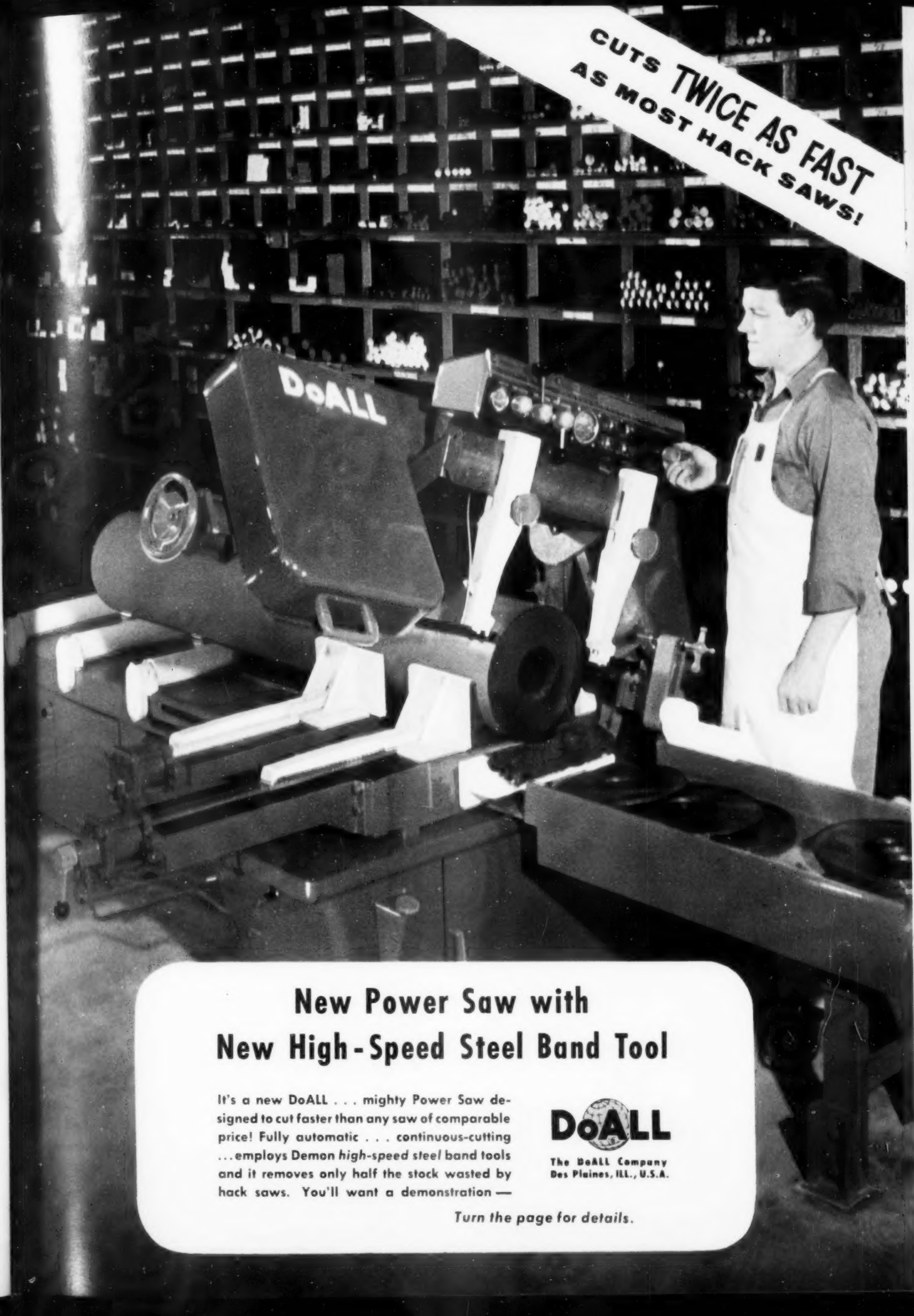
For example, look at the three machines shown here—fairly typical examples of what we have been able to do in simplifying complicated machining problems. Here is the essence of these machines—Drill Units and Tap Units, mounted simply and sturdily at the proper angles, programmed to operate in a suitable cycle, and with work-holding fixtures employing ingenious new features. If you like, you can buy our Drill or Tap Units separately and mount them up to suit yourself.

WRITE FOR FREE DATA

At any rate, get acquainted with what we have to offer. Write for our literature because it not only describes our Units in detail but also gives many application examples which may stir up your imagination. The more you know about us, the better chance we have of doing you some good.

REHNBERG R-J JACOBSON

REHNBERG-JACOBSON MANUFACTURING CO.
Special Machinery
2137 KISHWAUKEE ST. ROCKFORD, ILLINOIS


CUTS TWICE AS FAST
AS MOST HACK SAWS!
DoALL
New Power Saw with
New High-Speed Steel Band Tool
It's a new DoALL . . . mighty Power Saw designed to cut faster than any saw of comparable price! Fully automatic . . . continuous-cutting . . . employs Demon *high-speed steel* band tools and it removes only half the stock wasted by hack saws. You'll want a demonstration —
Turn the page for details.
DoALL
The DoALL Company
Des Plaines, ILL., U.S.A.

Users tell you how

These two cut-off wheels top all others

Reports prove Norton rubber bonded R50 and resinoid bonded B9 wheels save on the widest range of wet and dry applications

For wet cutting

Users' reports on how the Norton R50 adds the profit-boosting

"TOUCH of GOLD"

Wheel life tripled — Massachusetts tool manufacturer says R50 wheel, cutting-off high speed steel tap stock, lasted three times as long as best competitive wheel. Job required very smooth cut, with no burr or burn.

Best in every way — Illinois maker of combination doors and windows reports R50 wheel produced best quality cut, fastest cutting action, longest life for cutting extruded aluminum frames.

Longer lasting, superior cutting — Rhode Island oil seal manufacturer reports R50 wheel, cutting-off stainless steel, gave considerably longer life with better quality cut than any other wheel.

70% more durable — New York steel company says R50 wheel beat durability records of two best previous cutting-off wheels by 70%. Work was on high speed and carbon tool steels.

First among four — Pennsylvania manufacturer of coal mine bits reports R50 best wheel used for cutting alloy steel bit stock. Far superior, in quality of cut and durability, to three other wheels tried.

The Norton R50 rubber bonded cut-off wheel is designed especially for wet cutting of ferrous bar stock up to 6" diameter. It is the wheel to use where quality of cut, without burning, is important. Built-in chip clearance — unusual in this type of wheel — is one of many "Touch of Gold" advantages for better cutting performance and longer wheel life.

For dry cutting

Users' reports on how the Norton B9 adds the profit-boosting

"TOUCH of GOLD"

100% more cuts — New Jersey foundry switched to B9 wheels for cutting "Christmas tree" risers from precision castings, after tests in which B9 gave twice as many cuts.

Five times better — California naval shipyard re-orders B9 wheel for aluminum cutting jobs. Reason: B9's 5 to 1 superiority over best previous wheel.

Best general purpose wheel — Massachusetts manufacturer of molded rubber products reports the B9 best all-around cut-off wheel in their experience. Chief jobs were cutting various types of steel up to 3" diameter.

Unbeatable on Inconel — Pennsylvania bearings company says it found no other wheels to compare with the B9 for cutting Inconel bar stock. Outperformed competitive wheels on all counts.

565 more cuts — Massachusetts manufacturer of textile equipment reports B9 wheel produced 700 cuts on 1 x ½ x ⅛" steel channels. This topped previous wheel's record of 135 cuts by 565 — for five times longer wheel life.

The Norton B9 resinoid bonded cut-off wheel is recommended for high production dry cutting jobs, especially where fast rate of cut is essential. It is made with either smooth sides or the rough "F" sides for more clearance in the cut. It will give you long, economical "Touch of Gold" performance in the widest range of ferrous and non-ferrous applications.

Is wet or dry cutting best for YOU? — Ask your Norton distributor

If your cut-off wheels are performing poorly, or wearing out too rapidly, perhaps you ought to check your methods as well as your wheels. You may, for example, be dry cutting, when wet cutting would be more efficient — or vice versa.

Your Norton Distributor's abrasive specialist or your Norton Abrasive Engineer is always ready to give you plenty of practical information on cut-off *methods* — information that can save you money every day.

See your Distributor soon, or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities, listed under "Grinding Wheels" in your phone directory yellow pages. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Mass.

Making better products... to make your products better

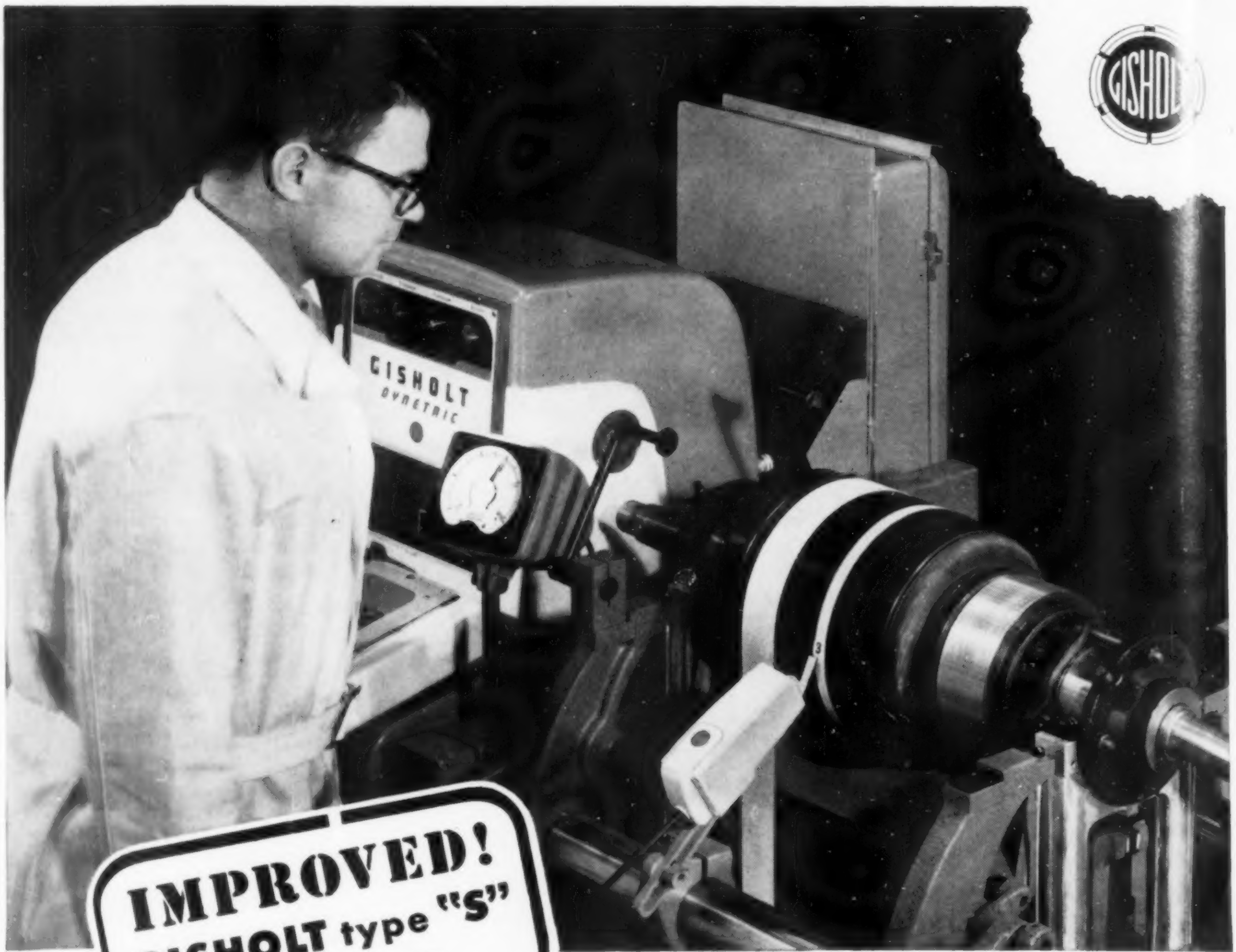
W-1602

NORTON

and its BEHR-MANNING division

NORTON: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING: Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes


SUPERFINISH
BORES REDUCE
TOOL WEAR
KNURLED HEADS
PROVIDE
GOOD GRIP
UNIVERSAL DRILL BUSHINGS
industry's standard of quality and service
100%
CONCENTRICITY
AND HARDNESS
TESTS INSURE
ACCURACY
BLENDED
RADIUS
HELPS PREVENT
TOOL HANG-UP
Universal Drill Bushings are available in a complete range of standard sizes and lengths. Special sizes made to order. Vastly increased production facilities assure immediate deliveries. Write to the office nearest you, Universal Engineering Sales Co., 1060 Broad St., Newark 2, N. J.; 5035 Sixth Ave., Kenosha, Wis.; or the home office.
UNIVERSAL
ENGINEERING
COMPANY
FRANKENMUTH
MICHIGAN
U
Universal products include:
Standard Collet Chucks, Floating Collet Chucks, Boring Chucks, "Kwik-Switch" Tool Holders, Mikro-Lok Boring Bars, Standard Drill Bushings, and Universal Index Plungers. Write for catalog.
189
UNIVERSAL ENGINEERING COMPANY
FRANKENMUTH 3, MICHIGAN



IMPROVED! GISHOLT type "S" Balancers

still simpler operation
with fewer controls . . . easier readings

Yes, we've made it possible for you to handle all balancing faster and easier than ever before.

On these improved Type "S" Balancing Machines you have but two operating controls, one for indication of amount and location of required correction in each plane. Amount and location of correction are shown simultaneously—on a uniformly graduated scale with large, easy-reading pointer and dial.

These are a few of the new features which years of broad production and maintenance experience have proved desirable. And Gisholt, always first in balancing, is first again to bring you new standards of performance.

The improved DYNETRIC Type "S" Balancing Machines are offered in both horizontal and vertical models, capable of balancing workpieces ranging from a few ounces to several hundred pounds.

Why not get complete details?

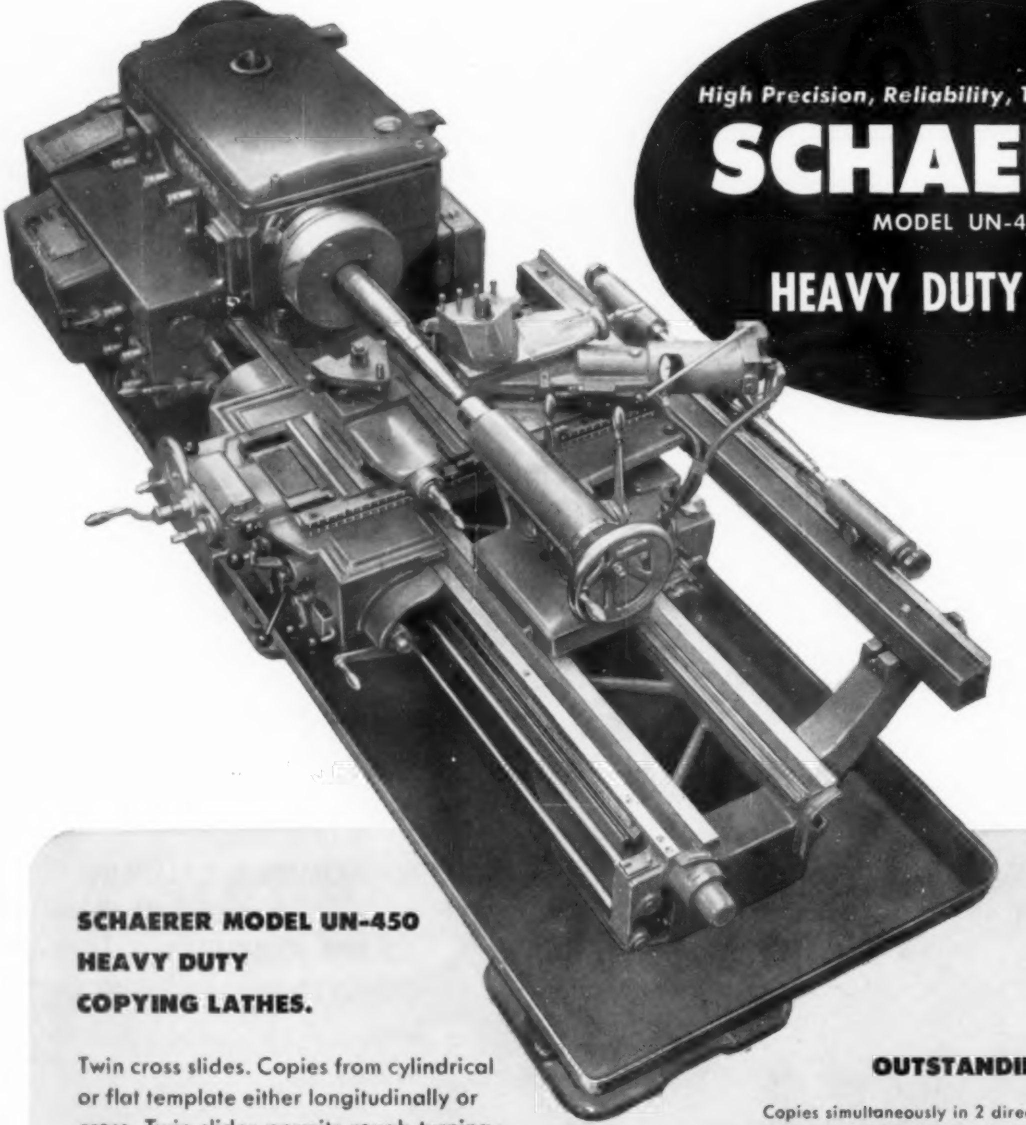
GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

DYNETRIC BALANCERS — GISHOLT — DEVELOPED JOINTLY WITH WESTINGHOUSE ELECTRIC CORPORATION "DYNETRIC" IS A TRADE MARK REG. U. S. PAT. OFFICE BY WESTINGHOUSE ELECTRIC CORPORATION

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-43



High Precision, Reliability, Top Performance

SCHAERER

MODEL UN-450

HEAVY DUTY LATHE

SCHAERER MODEL UN-450
HEAVY DUTY
COPYING LATHES.

Twin cross slides. Copies from cylindrical or flat template either longitudinally or cross. Twin slides permits rough turning and finish turning in the same operation in many instances. Swings 17-3/4" over bed, 9" over carriage, 20-5/64" over gap. Center distance 60". Spindle speeds 31.5 to 1400 R.P.M. Hydraulic copying attachment can be removed to permit use as a regular twin slide lathe when necessary. 10 H.P. motor drive to spindle. Separate motors for coolant and hydraulic pump. A production lathe built to tool room standards.

OUTSTANDING FEATURES

Copies simultaneously in 2 directions; 49 longitudinal and cross feeds; All gears in headstock hardened and ground; Automatic carriage release when overloaded; Separate oiling systems for front and rear end bearings; Ball stop catch on cross slide guarantees accurate depth adjustment for thread cutting; Adjustable carriage stop for longitudinal turning.

- *Guaranteed Service by Trained Staff*
- *Engineering Staff will make recommendations based on your requirements*
- *Spare Parts in Stock*
- *Your Operators Trained*
- *Early Deliveries — Some from Stock*
- *Competitive Prices*
- *Financing and Rental Plans to Meet Your Requirements*

Many More Machines for Every Operation

Write for free illustrated brochure 100, or state your specific requirements.

Representatives in the United States

M. B. I. EXPORT & IMPORT LTD.

A Division of Machinery Builders Inc.

Over twenty years experience in designing and building machinery

475 GRAND CONCOURSE, BRONX 51, NEW YORK

CABLE ADDRESS: MACHBUILD, NEW YORK

Also United States Distributors of Low-Cost Small Tools & Accessories

Our headquarters in New York City

MBI

measuring up

...and **REX** is the standard by which all high speed steels are compared

An older brother sometimes makes a handy yardstick for measuring junior's growth. And when it comes to tool steels, REX® High Speed Steel is — and has been for over 50 years — the standard of comparison.

There's no mystery to REX High Speed Steel. Its quality has been time-tested in thousands of shops. And after all, it's performance — not claims — that really counts. Make your *own* comparison test. Put REX High Speed Steel to work. Compare its structure, finish, hardenability, carbide distribution and general uniformity. You won't find another high speed steel that surpasses REX.

Remember, too, that even though it is widely distributed and used, REX High Speed Steel is made *only* by Crucible. So for tops in high speed steel performance, be sure you order the Crucible REX brand.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking

TOOL STEELS

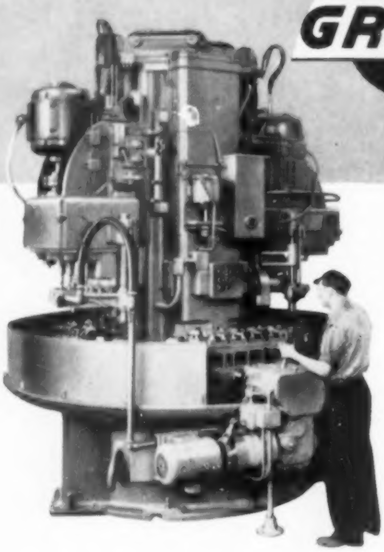
CRUCIBLE STEEL COMPANY OF AMERICA · TOOL STEEL SALES · SYRACUSE, N. Y.

PRODUCTION MACHINERY

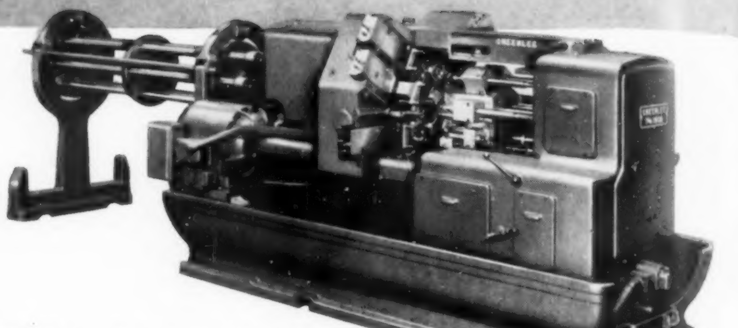
GREENLEE AUTOMATICS

PRODUCTION MACHINERY

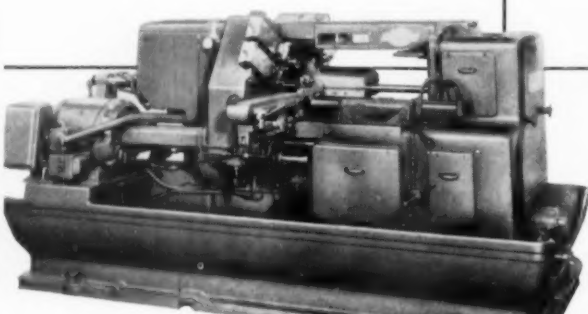
GREENLEE SPECIAL MACHINES



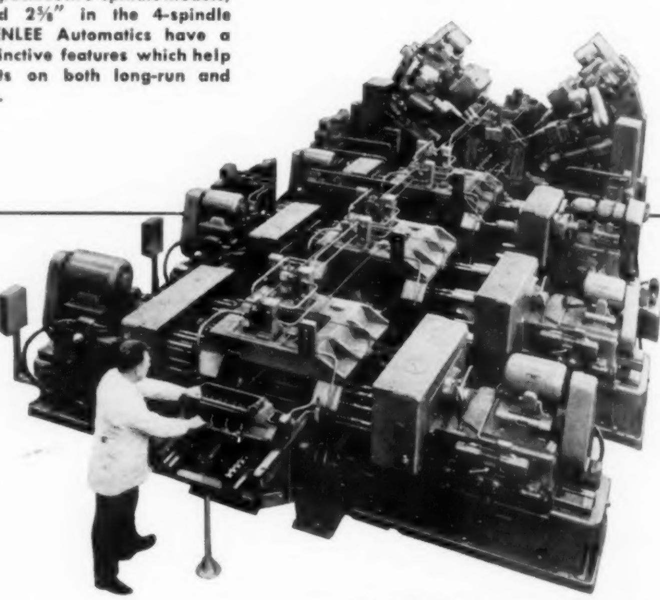
This is an example of a Vertical-type Special-purpose Four-station Automatic Indexing Machine designed and built to perform a number of important operations on connecting rods for an automobile engine.



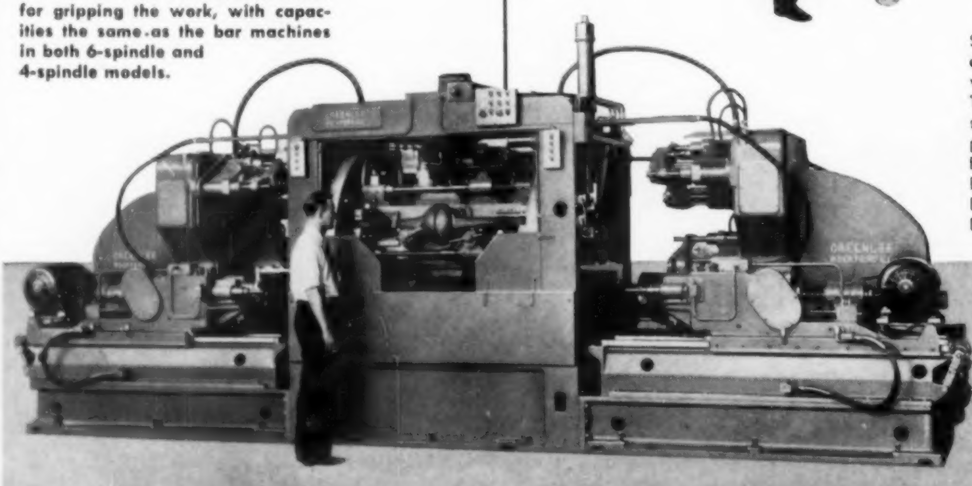
GREENLEE Automatic Screw Machines are made in several standardized types and sizes. The regular bar machines are 1", 1⅝", and 2" capacities in 6-spindle models, and 1⅝" and 2⅝" in the 4-spindle models. GREENLEE Automatics have a number of distinctive features which help to lower costs on both long-run and short-run jobs.



GREENLEE Automatics are also made for second operation work, an example of which is shown here. Collets are used on these machines for gripping the work, with capacities the same as the bar machines in both 6-spindle and 4-spindle models.



Since 1935 GREENLEE has pioneered in the design and manufacture of Automatic Transfer Machines widely used in the big mass-production factories. The example shown here is a comparatively small and compact six-station machine which performs a group of operations on the ends and head faces of a V-8 cylinder block. Some of the bigger GREENLEE Transfer Machines will do several hundred operations in a cycle time of less than half a minute.



At the left is another GREENLEE Special Machine, in this case a Horizontal, Two-way, Four-station, Drilling, Boring, and Tapping Machine for finishing a series of holes in the ends of rear-axle housings. GREENLEE experience is available for the design and manufacture of a wide range of such cost-reducing machines.

GREENLEE BROS. & CO. 1981 Mason Ave., Rockford, Illinois

Mallory No-Chat* Shanks

end tool vibration problems

NEEDLESSLY high machining costs caused by tool chatter can now be substantially reduced by using Mallory *No-Chat* tool shanks and boring bars. Made of a special high density metal developed by Mallory research, *No-Chat* shanks stop tool vibration at its source. The higher initial cost is quickly repaid many times over by these production savings . . .

HEAVIER CUTS can be made without chatter.

SMOOTHER CUTS—finish grinding can often be eliminated.

LESS DOWN TIME—tools run longer between grinds, because wear caused by vibration is reduced, and because tools run cooler due to *No-Chat's* high heat conductivity . . . three times that of steel.

*TRADE MARK. PATENT APPLIED FOR

BORING BARS of *No-Chat* can be used with large length-to-diameter ratio without fear of breakage . . . and are being used successfully to turn small internal diameters that formerly had to be finished by grinding.

SHANKS ARE RE-USABLE—new tips are readily brazed in place. *No-Chat* metal does not anneal . . . eliminates grain growth problems.

This new concept in cutting tool performance can make big improvements in the tools you manufacture or use. For details, write for a copy of our *No-Chat* Technical Bulletin.

Expect more . . .
Get more from **MALLORY**

In Canada, made and sold by Johnson Matthey & Mallory, Ltd., 110 Industry Street, Toronto 15, Ontario.

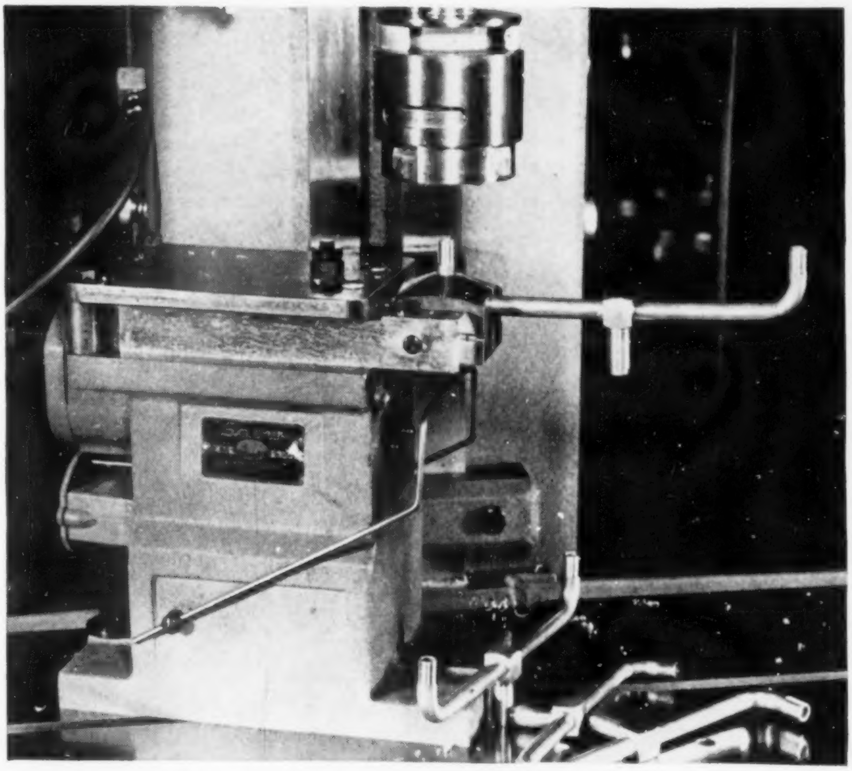
Serving Industry with These Products:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

For information on titanium developments, contact Mallory-Sharon Titanium Corp., Niles, Ohio

Quicker changeover, lower tooling costs...

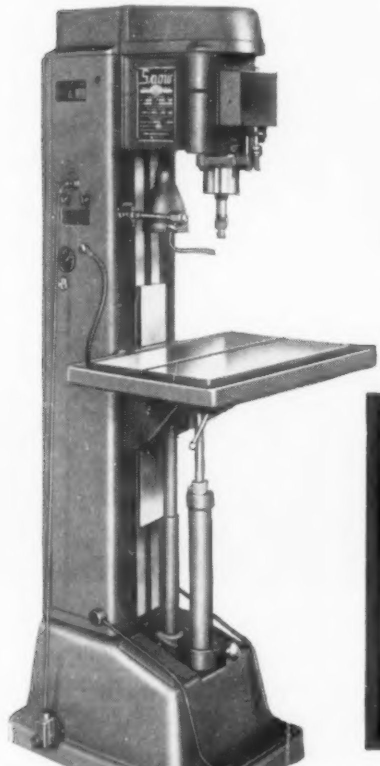
with SNOW FULL UNIVERSAL MACHINES



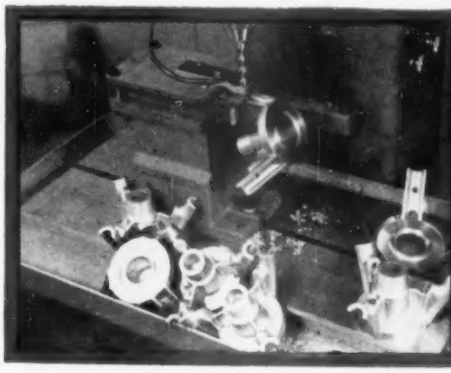
ELECTRICALLY OPERATED AIR CONTROLLED AUTOMATIC OR SEMI-AUTOMATIC

Basic Master Fixtures for DRILLING, THREADING or TAPPING. Snow universal machines are the most flexible, most efficient, and most economical known. They save countless dollars in changeover time — help you start jobs sooner — assure quality at high production rates.

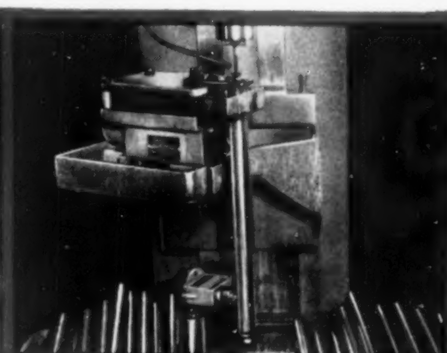
The square footage under a Snow Machine in your factory can be the most profitable in your whole plant. Submit details of your requirements.



AIR VISE holds part firmly — self-centering — always in exact position for precision work. U-shaped wire underneath provides quick finger-tip control, automatically starting spindle cycle. Jaw inserts keep tooling costs at minimum. Blank jaws always in stock — can be tooled to fit your part promptly, inexpensively.



Irregularly shaped parts are easily handled. Front feed permits close setting of guide plate for greater accuracy with high production.



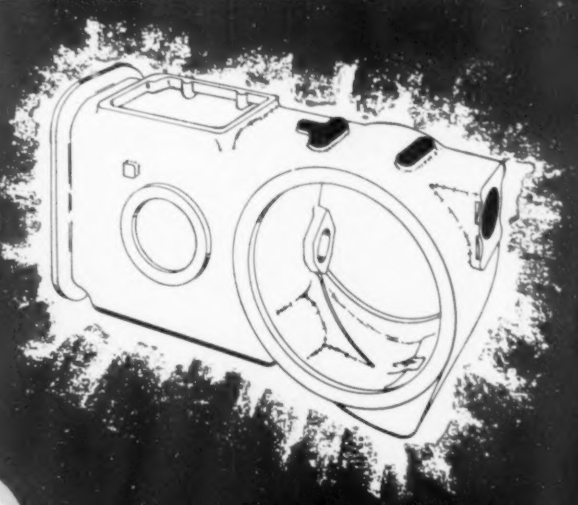
Here a short AIR VISE mounted on an offset table holds long tubing. Piece-part switch under table automatically closes vise and starts tapping operation.

SNOW MANUFACTURING CO., BELLWOOD, ILL.
(Suburb of Chicago)

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-49

CUSTOMER SPECIFIED

Leading farm machinery manufacturer asked Kearney & Trecker to design a machine that would bring new efficiency to the milling and boring of large tractor housings.

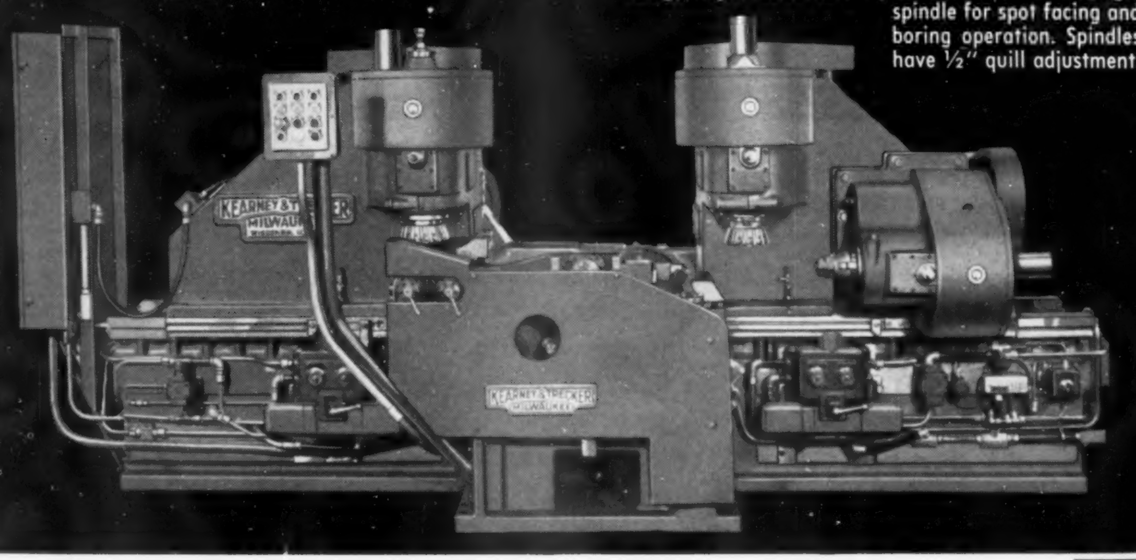


Black indicates machined surfaces.

KEARNEY & TRECKER DESIGNED

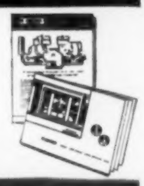
Kearney & Trecker built this special two-way boring and milling machine which simultaneously performs four operations on the tractor housing. Close tolerances were necessary not only in size but also in squareness of finished piece.

Left hand traveling head has two spindles—a horizontal for milling side flange and a vertical for milling top flange. Right hand traveling head incorporates a single spindle for spot facing and boring operation. Spindles have ½" quill adjustment.



New production efficiency starts with Kearney & Trecker Milwaukee machine tools

For more details on the machine illustrated ask for Data Sheet No. 1015. The free booklet "Doorway to a proven method for solution of big and small metalworking problems" is also yours for the asking.



This typical example proves you can reduce costs and start on the road to higher production with machines designed and built by Kearney & Trecker's Special Machinery Division. With more than 50 years' experience in machine design and manufacture, Kearney & Trecker has all the ingenuity and skill required to solve special machining and production problems.

Why don't you take advantage of our abilities? They can pay off in profits for you. Your Kearney & Trecker Special Machinery Division representative will be pleased to give you all details. Call him today!

KEARNEY & TRECKER MILWAUKEE MACHINE TOOLS

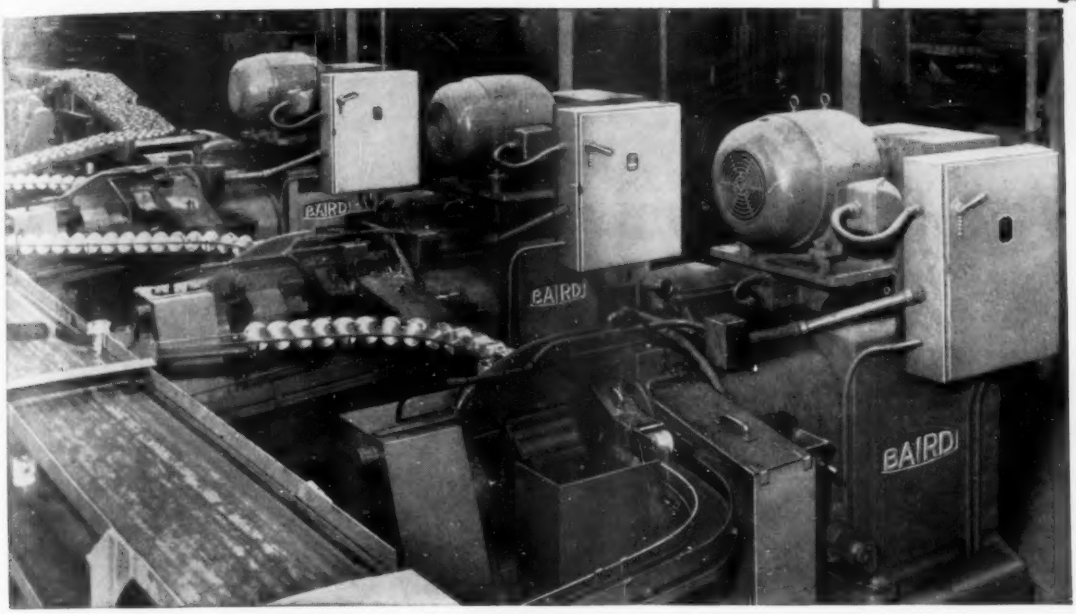
Special Machinery Division

MILWAUKEE 14, WISCONSIN, U.S.A.

Builders of Precision and Production Machine Tools Since 1898

ASK BAIRD ABOUT IT

. . . IF IT'S A HIGH PRODUCTION PROBLEM . . .



ENGINE PISTONS *travel fast* THRU *automatic* ASSEMBLY of BAIRD 6-SPINDLE CHUCKERS

With push-button operation in many large metal working plants, the Baird Chucker has graduated from a valuable single unit to an invaluable assembly for completely automatic production lines.

Higher, constant speed is one reason . . . minimum manpower . . . and maintenance of close tolerances during continuous removal of metal is, perhaps, the outstanding feature. The photo above shows an assembly of three Baird Chuckers automatically machining engine pistons in a leading automobile plant.

In this instance, operations include finish turning of the engine piston and finishing the oil ring grooves to size.

This Model 76H Chucker (7″ chucks, 6-spindle horizontal machine) combines, in a single indexing cycle, such operations as turning, facing, drilling, tapping, threading, grooving and chamfering, if required.

Electrical and mechanical safety devices prevent damage when any motions are out of time or sequence. All tooling is easily accessible . . . spindle speeds are individual and variable. Design and construction assure long service life. If you require repetitive production of this nature . . . hand load or unload or entirely automatic . . . ask Baird about it.

3BA54

THE BAIRD MACHINE COMPANY
STRATFORD CONNECTICUT

WHERE YOU WILL GET THE HELP OF SPECIALISTS ON THESE ESSENTIAL PRODUCTION PROBLEMS:

AUTOMATIC MACHINE TOOLS • AUTOMATIC WIRE & RIBBON METAL FORMING MACHINES • AUTOMATIC PRESSES • TUMBLING BARRELS

HORIZONTAL HEADS
Available in capacities from 3 to 100 HP.
HORIZONTAL TABLES
Available in widths from 10½" to 48" and feed strokes from 18" to 216".
INDEX BASES
Easily applied to standard Rigidmils for increased production by the elimination of loading time or improvement in accuracy by the machining of multiple surfaces with one handling of the work piece.
VERTICAL HEADS
Available in capacities from 7½ to 50 HP.
From These Elements...It's Easy To Get What You Want From SUNDSTRAND
VERTICAL FEED UNIT
This unit provides vertical feed and rapid traverse in combination with the table movement for square cycles, clearing obstructions on work piece, etc.
ADJUSTABLE COLUMNS
Movable columns provide maximum cutting rigidity for horizontal heads over a wider range for milling both large and small work pieces.
AUTOMATIC QUILL POSITIONING
Positions the cutter for multiple depths of cuts and provides automatic cutter relief.
RAIL TYPE HEAD
Way type rail provides extreme accuracy over wide range of adjustment for vertical spindle head.
ROTARY TABLES
Available in several sizes for continuous or rotary milling operations.
ATTACHED VERTICAL HEAD
Driven from horizontal spindle this attachment increases possible uses of standard Rigidmils.
AUTOMATIC LATHES
SIMPLEX RIGIDMILS
DUPLEX RIGIDMILS
SUNDSTRAND
"Engineered Production Service"*
*REG. U.S. PAT. OFF.

This *Cadillac*

6" PLA-CHEK GAGE

IS ACCURATE to .00005"

Cadillac

PLA-CHEK

For checking smaller jobs, gages, tools and dies, this portable 6" Cadillac PLA-CHEK Gage is accurate to .00005". It can easily be checked in and out of your tool crib to be used on the surface plate or at the machine. It is completely self-contained and extremely simple in operation. Speeds inspections from minutes to seconds.

Capacity of the 6" PLA-CHEK model can be increased by the addition of a 6" riser without affecting accuracy or sacrificing portability. Send coupon TODAY for complete details!

MAIL THIS COUPON FOR COMPLETE DATA

CADILLAC GAGE COMPANY
P. O. BOX 3806, DETROIT 5, MICHIGAN
Without obligation please rush complete information on the Cadillac PLA-CHEK Gage line to:

Name____________________
Company____________________
Address____________________
City__________ Zone____ State______

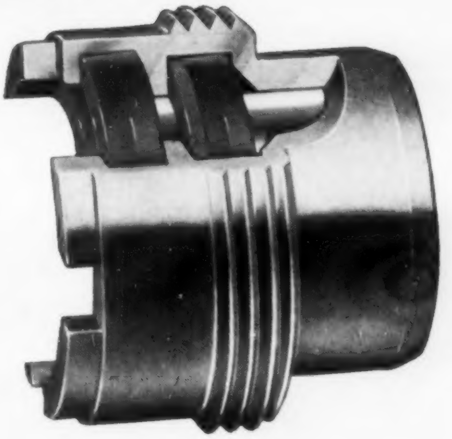
Cadillac
GAGE COMPANY
P.O. BOX 3806 • DETROIT 5, MICH.


First choice of cost-wise buyers
BOSTON Gear ®
6562 "off the shelf" STANDARD STOCK TRANSMISSION PRODUCTS
STOCK GEARS: Spur • Racks • Miter • Bevel • Helical • Worms and Worm Gears
SPROCKETS and CHAIN
For drives ranging from fractional to 40 hp
SHOLD-A-GRIP
Interchangeable Tapered BUSHINGS and SPROCKETS
Fit sprockets up to 24" pitch dia. to any shafts ½" to 3" by 16ths
BOST-BRONZ
oil-impregnated BEARINGS
RATIOMOTORS
Motorized Speed Reducers
32 types—1/20 hp to 3 hp
REDUCTORS
Standardized Speed Reducers
.005 hp to 36 hp
Certified BEAR-N-BRONZ
Solid Bronze BEARINGS
PILLOW BLOCKS
COUPLINGS
UNIVERSAL JOINTS
BALL BEARINGS
Send for your copy
STANDARDIZED TO SIMPLIFY YOUR MAINTENANCE AND DESIGN
Standardized, completely interchangeable, precision Gear Products, they meet practically all needs, for maintenance replacements, for machinery built for plant use, for drive assemblies in products you make.
IN STOCK NEARBY—NO DELAYS AND COSTLY DOWNTIME
In emergencies, can be delivered immediately, saving downtime.
FIRST QUALITY AT LOWER COST
BOSTON GEAR quality control gives you unequalled precision, finish, and performance. Compare costs — the savings will surprise you.
SELECTION ADVICE FROM SPECIALIST
Information is quickly available from your Distributor's factory-trained specialist, or BOSTON GEAR Field Engineer when desired.
PRODUCTION QUANTITIES— REDUCTORS and RATIOMOTORS
BOSTON GEAR Engineering Dept. will help you design custom built, high-efficiency, low-cost Ratiomotors or Reductors into your product. Send prints and specifications. A qualified Field Engineer will call at your request.
WIDEST SELECTION
BOSTON GEAR Catalog lists 102 Product Groups — includes 30 pages of engineering data. Get a copy from your BOSTON GEAR Distributor or write Boston Gear Works, 83 Hayward St., Quincy 71, Mass.
54-AP4
At 96 Authorized BOSTON Gear Distributors . . . a $10,000,000 stock for "off-the shelf" deliveries
Look under "Gears" in the Yellow Classified Section of your Telephone Directory for Distributor nearest you
ORDER FROM YOUR NEARBY
BOSTON Gear ®
DISTRIBUTOR—at Factory Prices

TYPE CYLINDERS

BOTH WITH NEW, CARTRIDGE GLAND

...externally removable and replaceable without dismantling cylinder!



Here's the biggest improvement in cylinder design in the last 50 years. This exclusive Hannifin gland is a bronze cartridge, externally removable and replaceable as a unit to meet J.I.C. recommendations. A face type spanner wrench is the only tool you need. Now look at the packing! The "Wiperseal" serves a dual purpose as it wipes both ways to provide a dry rod on the out-stroke, a dirt-free rod on the in-stroke. The "Lipseal" is self-compensating, self-relieving and non-adjustable . . . provides an efficient seal throughout its long life. Ask for a demonstration . . . every Hannifin man carries a cutaway sample of this "jewel" of a gland with him at all times.

SERIES "H" HYDRAULIC CYLINDERS

Made in 9 bore sizes from 1½" to 8" . . . 13 standard mountings . . . many combination mountings. Extremely close tolerances for easy mounting. Heavy-duty tie rods. Steel heads. Steel cylinder bodies "Tru-Bored" and honed to a satin finish. Piston rods ground and polished then hard chrome plated for minimum friction and long packing life.

TYPICAL MOUNTING STYLES

Clevis Mounted · Standard Rod End Flange · Flush Type · Side Lugs

Heavy Duty Blind End Flange · Standard Blind End Flange · Trunnions at Rod End · Angle Mounted

WRITE FOR BULLETIN 113

Get your copy of this complete, easy-to-use catalog today. Everything you need to order from is here.

HANNIFIN

Hannifin Corporation, 519 South Wolf Road, Des Plaines, Illinois

Air and Hydraulic Cylinders • Hydraulic Power Units • Pneumatic and Hydraulic Presses • Air Control Valves

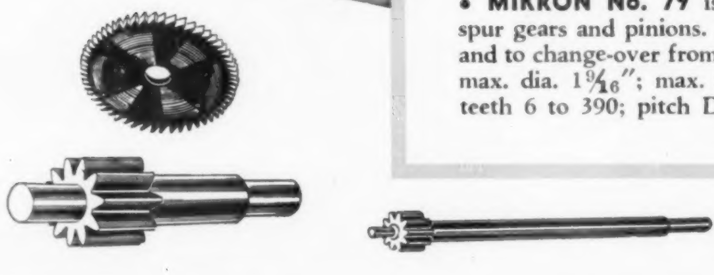
for Precision

+ Low Cost:

MIKRON

GEAR HOBBER #79

Mikron Hobbing Machines Excel Where High Precision Machining Standards Must Be Maintained



• **MIKRON No. 79** is an excellent choice for small spur gears and pinions. It is simple to operate, to set-up and to change-over from job to job. CAPACITY: Gears, max. dia. $1\frac{9}{16}$"; max. length of cut $1\frac{1}{8}$"; number of teeth 6 to 390; pitch DP 26 and finer.

RUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue, New York 17, N. Y.

Polishing goes automatic

goes automatic

...with *BEHR-MANNING* coated abrasive belts

Lapping For Precision Flatness and Parallelity in Production Quantities

. . . with a LAPMASTER

This is the machine for you if you want precision flatness in production quantities at low cost. Lapmasters readily lap to the extreme close tolerance of one light band (.0000116") or less. In addition they produce an extremely fine finish to as low as 1 RMS. They are available with 12", 24", 48", 72" or 84" lapping plates.

THIS IS HOW THE LAPMASTER WORKS

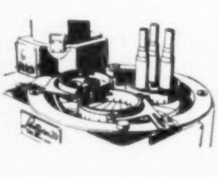
I, a heavy cast iron lap plate revolved slowly under power. **II,** large cast iron conditioning rings are held in position and rotate freely on the lap. **III,** work pieces are placed inside the conditioning ring where they also rotate on the lap. **IV,** a liquid vehicle containing fine loose abrasive flows on the lap plate and is uniformly distributed under the work pieces. At the same time the rotating conditioning rings preserve the flatness of the lap plate. These three essential features, combined with the rapid cutting action of loose abrasive produces a flatness which meets every production requirement.

1 Operator requires no previous lapping experience.

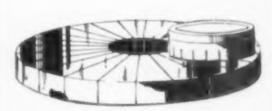
2 Lapping with loose abrasive and without excessive pressure eliminates heat and subsequent distortion.

3 Simplicity of design provides accessibility and allows ease of loading and unloading.

4 Loose abrasive distributed evenly over lapping area insured uniform results.



5 Precision laps identical parts in one cycle or parts of various shapes, heights and materials in one cycle.

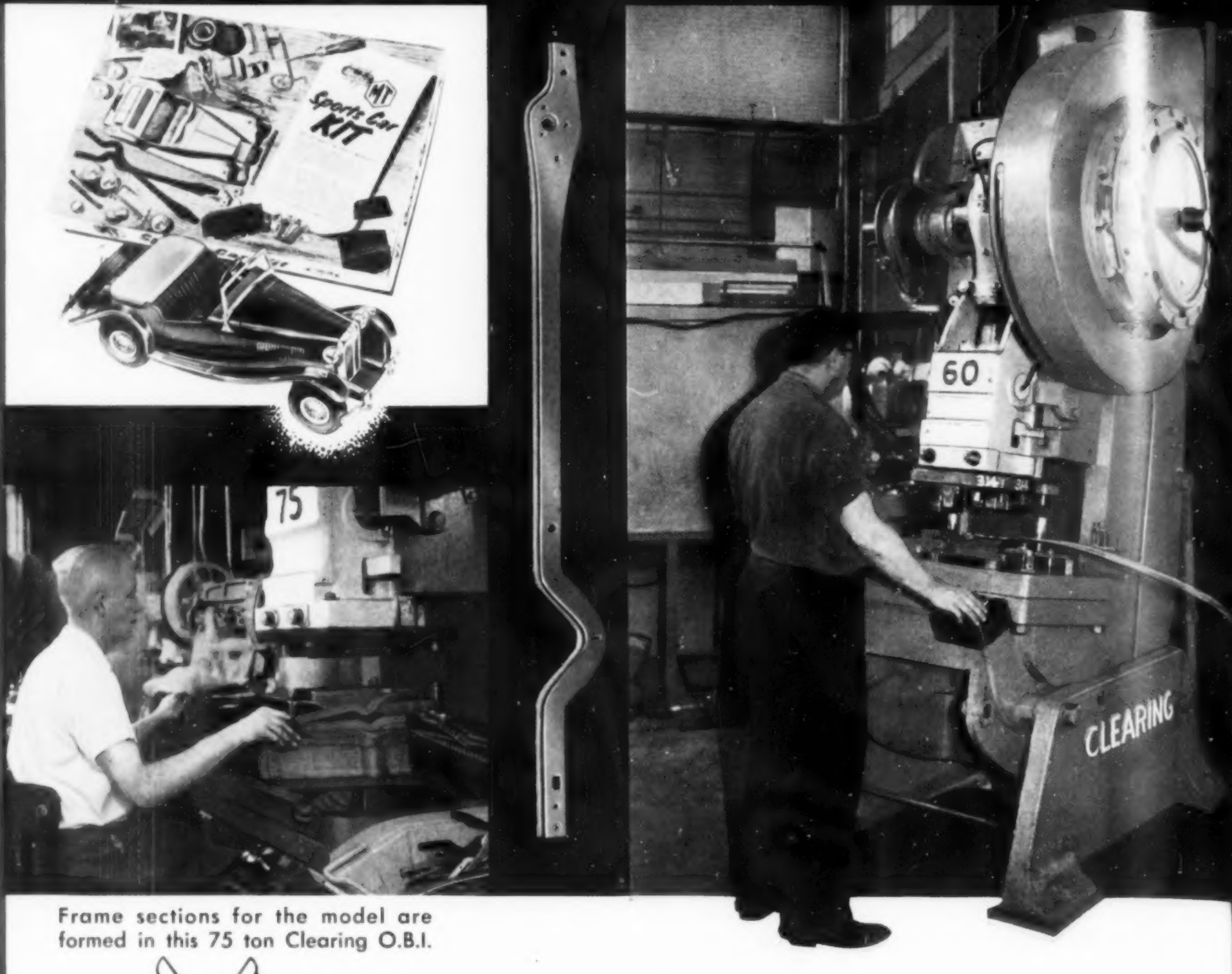


6 Lap plate always kept in condition while in operation. No down time required for truing or reconditioning.

Learn more about the possibilities of production lapping and the interesting subject of measuring flatness. The illustrated fact-filled booklets are yours for the asking. Write today.

CRANE PACKING COMPANY
Dept. TE-1, 1823 Cuyler Ave., Chicago 13, Illinois
In Canada: Crane Packing Company Ltd.
617 Parkdale Ave. N., Hamilton, Ont.

CRANE PACKING COMPANY



Frame sections for the model are formed in this 75 ton Clearing O.B.I.

The Tool Engineer

A Bold Approach for the Future

This year commences with an ever-growing tide of automation in industries throughout this country. The first half of this century saw our great country and Canada lead the world in the understanding and application of mass production methods in industry. The leadership in the second half century will be won by those understanding and systematically applying automation to the manufacture of their products.

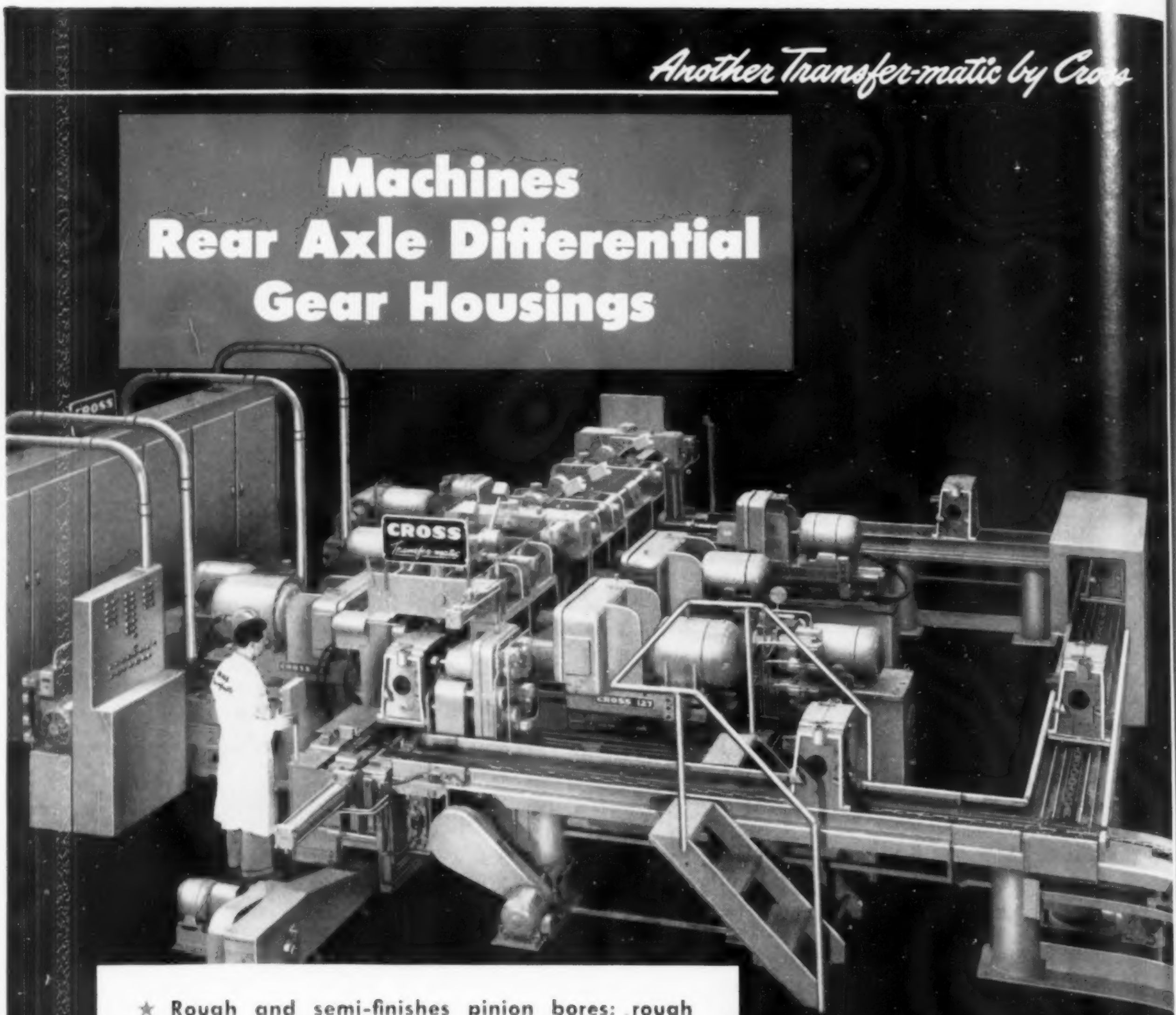
By automation, we mean the effective integration of manufacturing methods and equipment to provide a unified over-all production flow. This demands engineering vision and decision looking far into the future.

Already we have realized the benefits, and some of the hazards of automation. By sound engineering practice, and efficient tooling, and intelligent imagination, automation can become the answer to world trade in the years to come. Our high standards of living and wages force us to use our highest engineering skills to compete in foreign markets.

The tool engineer can be the answer to our climb to world leadership in the field of automation of industry. It is a challenge that no tool engineer will overlook. The latest "know-how" is a must that has to be studied. Technical meetings, trade papers and magazines, and discussions with your fellow members are some of the best ways to keep out in front.

Joseph P. Crosby

PRESIDENT
1954-1955


Another Transfer-matic by Cross
Machines
Rear Axle Differential
Gear Housings
CROSS
★ Rough and semi-finishes pinion bores; rough bores, semi-finish bores and taps cross bores.
★ 155 parts per hour at 100% efficiency.
★ 9 stations—1 for loading, 4 for boring, 1 for tapping, 2 for indexing, 1 for visual inspection.
★ Pallet-type work holding fixtures.
★ Hydraulic power wrench for clamping parts.
★ Automatic transfer of fixtures from station to station.
★ Other features: Complete interchangeability of all standard and special parts for easy maintenance; construction to J.I.C. standards; hardened and ground ways; tandem drive for locating pins; hydraulic feed and rapid traverse; automatic lubrication; oil-mist lubrication for taps; drag-chain type chip conveyor.
Established 1898
THE CROSS CO.
DETROIT 7, MICHIGAN
Special MACHINE TOOLS

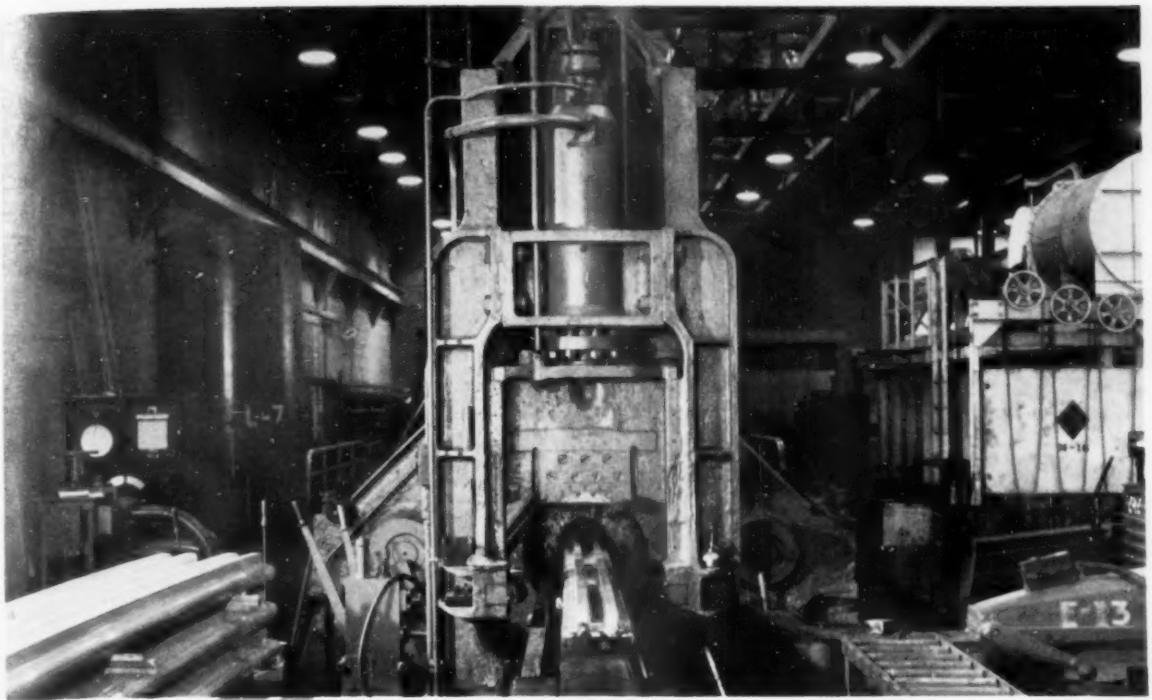


Fig. 1. Typical extruded part emerging from die of extrusion press.

New extrusion techniques

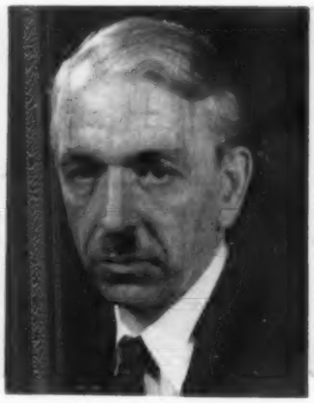
By E. J. de Ridder

Director, Application Engineering
Reynolds Metals Co.,
Louisville, Ky.

Few if any manufacturing processes can claim the interesting design potential of aluminum and magnesium extrusion. Extrusions have introduced new possibilities for economic and efficient design to an industrial world that is continuously facing more stringent product requirements. A new process only several decades ago, extrusion of light metals, has been the most rapidly expanding metalworking method in the industry. Small nonintegrated producers have set up shop with a press, a billet furnace and simple straightening tools. Though plagued by metal scarcity, they have made progress in application of the process.

The excellent formability of aluminum billets in an extrusion press, *Fig.* 1, permits designs that cannot be produced in ferrous metals except by forming and joining a number of simple shapes to build up the complex section. The resulting steel part carries a heavy labor charge that frequently will overbalance the higher material cost of aluminum. In general, as the complexity of a section increases the cost advantage of steel parts decreases. In moderately complex shapes the advantage of steel in material costs will disappear and in the more complex sections aluminum extrusions have the advantage. Even in simple extrusions the excellent workability of the light metals allows them to compete favorably with steel. In many applications, such extrusions have further advantages of light weight, attractive natural appearance and resistance to corrosion.

Design concepts have forged far ahead of the immediate abilities of extrusion producers. Aircraft designers have been a continuous goading element. This industry is a demanding consumer that visualizes the advantages of a design and then insists that the manufacturer produce it. The requirements of



Ernst J. de Ridder, one of the foremost authorities on extrusion die design in this country, is a native of Siegburg, Germany. He graduated from the University of Berlin, where he also did graduate work in mechanical and aeronautical engineering. He was a designer with various German aircraft companies and then chief engineer of I. G. Farben Lightmetal Division from 1926 to 1945. From 1946 to 1949 he was a technical assistant to the English Ministry of Supply and British Magnesium, Ltd. In 1949, he joined Reynolds Metals Co., moving up in 1951 to his present position.

these designers are sound and their sober, yet far-sighted and enthusiastic, approach to modern design has been an essential stimulus to technical advances in extrusion engineering.

The growth of extrusion practice to date has been primarily one of straight-forward relatively uncomplicated extrusion dies and equipment. There is much room for advancement in this field but an even greater field of design potential lies in the relatively untouched fields of tapered extrusions, variable die extrusions and combination extrusion-forgings.

Much work of a developmental nature has already been done in these fields. A number of items have been successfully produced by these methods. This article deals with some specific production methods that, while still largely developmental, have advanced sufficiently to permit a sound prediction that they will be available for use on a production basis in the near future. The products of these new methods will be strongly significant factors in improved design and lower production costs.

Extrusions as Forging Stock

Current aluminum forgings are usually made from solid bars, or forging stock—a rolled blooming mill product available in standard mill sizes. Forging operations and forging dies are expensive and costs increase rapidly when several intermediate dies and operations must precede the forging of the final shape.

The use of extruded forging stock makes it possible to approach the cross section of the final forging in the forging stock with an appreciable saving in material as well as a direct saving in the cost of the forging operation itself, *Fig.* 2.

The same principle can readily be applied to the forging of a tapered T-section embodying a thickened end and a connecting flange in its design, *Fig.* 3. In this instance the use of stepped-extrusion forging stock simplifies the forging process with attendant economies in forging dies, operations and material.

New Extrusion Dies for Hollow Extrusions

The usual method of extruding tubes is to employ a hollow billet and a long mandrel, fixed or floating in the press ram. Another method of producing tubes or hollow shapes in various configurations is to fix a short mandrel on the extrusion die, *Fig.* 4.

Both methods have certain inherent disadvantages. Using the long mandrel it is necessary to drill a long hole into the billet. Tubes produced in this manner do not have uniform wall thickness since the mandrel cannot be made rigid enough to avoid some bending under the high extrusion pressure. The flow of material within a porthole die is somewhat irreg-

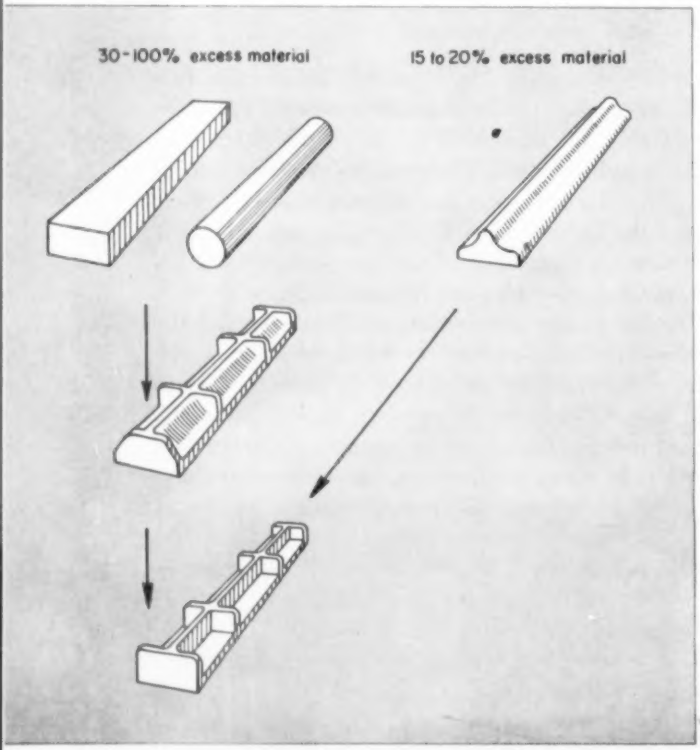


Fig. 2. Conventional forging part at left requires 30 to 100-percent excess material in the forging stock and a preliminary forging operation. Pre-extruding stock at right eliminates one forging step and one set of forging dies while reducing material waste 15 to 85 percent.

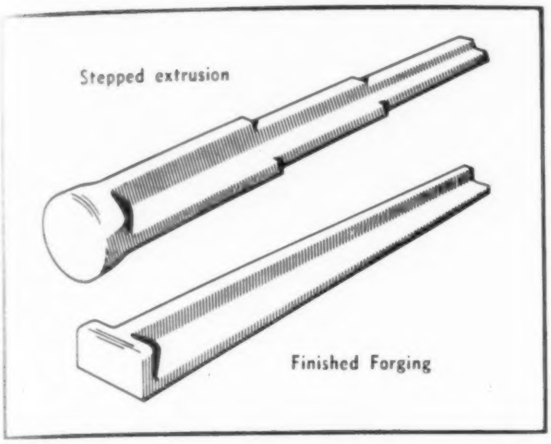


Fig. 3. Tapered forging (bottom) saves material by using stepped extrusion with billet butt as forging stock (top).

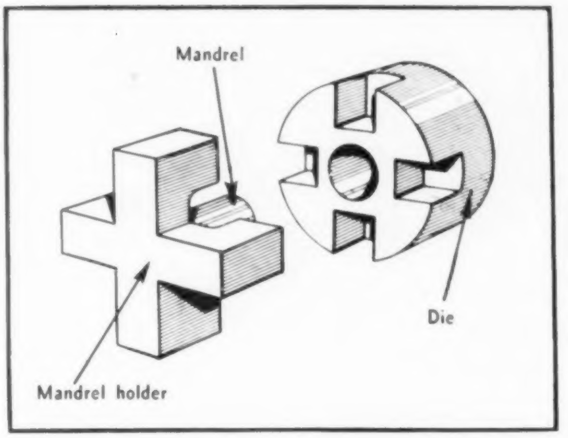
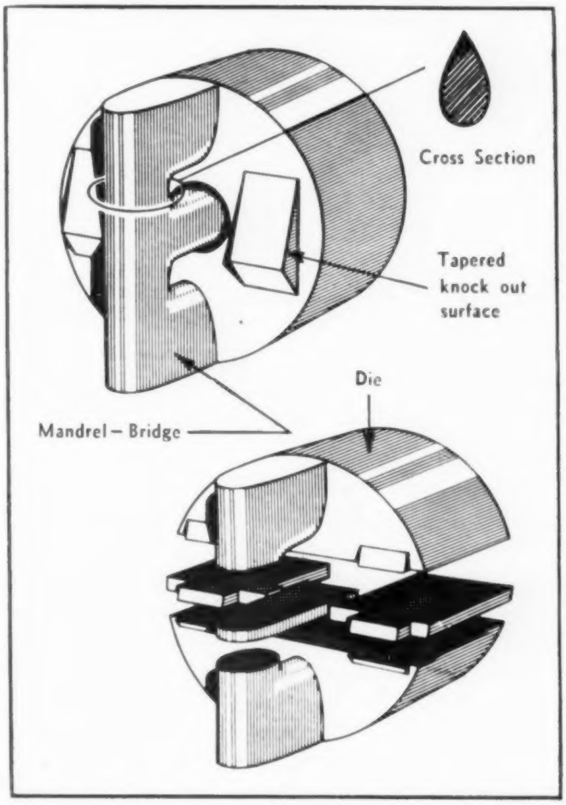


Fig. 4. Porthole die for extruding hollow shapes uses a short mandrel and holder positioned on face of the die.

Fig. 5. New bridge die streamlines metal flow. Tapered knockout surfaces move billet butt down and backwards, shearing tube from butt and clearing die for next "push." Cutaway view at bottom.



ular and gives lower quality extrusions. In addition, it is necessary to reduce the extrusion speed which increases the cost of the final product.

When extrusion is completed the billet butt remains in the die and cannot be removed except by extruding it out ahead of the next billet. Inasmuch as the butt end of an extrusion billet is an accumulation of the outer surface of the entire billet the first length of tube produced in successive extrusion is of poor quality and must be discarded. Also, the porthole die cannot be adequately cleaned between press cycles and die wear is excessive.

A new bridge die, *Fig.* 5, eliminates all of the difficulties inherent in the porthole die. The short mandrel along with the mandrel bridge is machined from one solid steel part and attached to the die. Flow of material close to the rear end of the die and through the die aperture is greatly improved, *Fig.* 5. When extrusion is completed the billet butt can be sheared from the tube and both can be readily removed from the die. The die is thus free from any metal prior to the next press cycle.

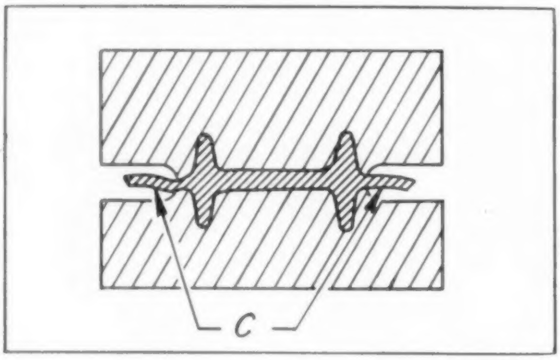
Shearing the billet from the die and tube is readily accomplished as the tapered rear surface of the die moves the billet butt backwards and down. The tube is sheared from the butt and readily pulled from the die.

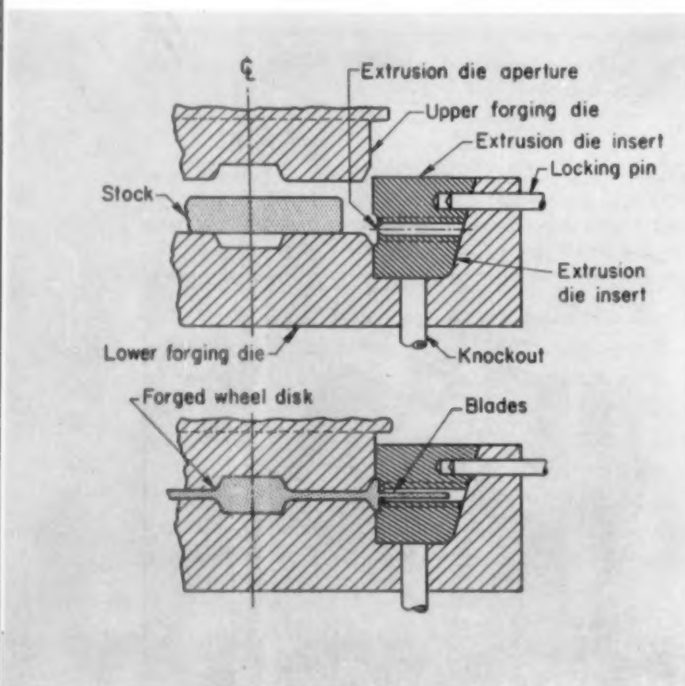
The new die permits higher extrusion speed, better extrusion surface and improved extrusion properties with significant operational economies. Test results have shown that this design principle can be used for extruding two or more hollow shapes from one billet in one stroke by using a multiple bridge die.

Combined Extrusion-Forging Operation

In the simplest concepts extrusion and forging processes are distinct and separate methods of flow forming cast billets or wrought forging stock to secure the fine grain structure and high properties of wrought material. Recent advances in extrusion and forging techniques have departed from these early simple operations that could be designated as either extrusion or forging and have developed flow forming practices that are essentially a combination of the two.

This combination of techniques in one operation and one die offers many interesting possibilities. Such a technique for producing forged turbine or





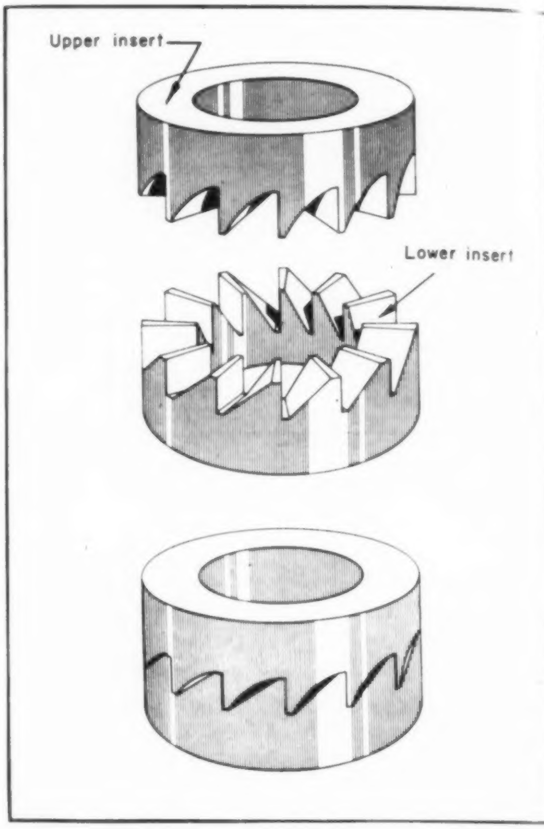


Fig. 6. (top left) Flow of flash material in a forging die at points C is perpendicular to the direction of the forging pressure. This illustrates principle used in combining extrusion and forging, Fig. 7.

Fig. 7. (left) Combination forging and extrusion die for forming turbine wheel disk and blades in one operation. See Figs. 6 and 8, also.

Fig. 8. (above) Over-all perspective view of two parts of a split extrusion die that is similar to the one shown in cross section through one of turbine blade cavities in Fig. 7.

compressor wheels with extruded blades as a single unit has been suggested years ago. *Fig.* 6 illustrates the steps in this new technique of combining forging and extrusion to produce shapes that are impossible by either process used separately. This figure is a simple illustration of the well-known fact that a portion of the material in the forged part will flow in a horizontal direction at points *C* when vertical pressure is exerted by the upper die of the forging press. If an extrusion die is located at the points *C* it will then be possible to produce a forging with integral extruded parts on both sides.

Application of this principle will permit forging a compressor or turbine wheel and extruding its blades as an integral part of the wheel in one operation. *Fig.* 7 illustrates one of many possibilities. The upper and lower forging dies are conventional, with inserts forming the extrusion die apertures in the form of the turbine blade cross section. *Fig.* 8 shows the split extrusion die components. A locking pin holds the inserts down during the forging-extrusion operation. A knockout pin is provided for easy removal of the finished part.

As shown in *Fig.* 7, the stock is forged by the upper forging die into the form of the wheel disk and at the same time the blades are extruded through the die aperture. The upper die is then withdrawn and the upper insert holds the forging in the lower die to avoid damage to the thin turbine blades. Removal of the locking pins allows the knockout pins to remove the entire forging and both extrusion die inserts from the lower die. The upper extrusion insert protects the blades during the knockout operation. Both inserts are then readily removed from the part.

This combined forging-extrusion method can be used either in a forging or extrusion press. In the latter case, the upper forging die is fixed on the ram and lower die mounted in the die holder of the extrusion press. The foregoing procedures may be divided into a number of progressive operations to

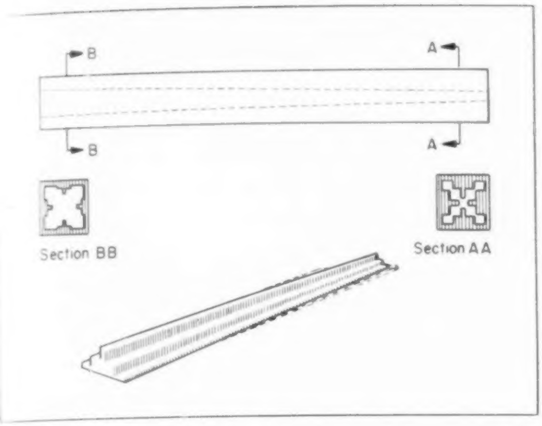


Fig. 9. Method of producing two or four tapered wingspar caps from one extrusion. Dies use tapered mandrel.

secure suitable flow of material during each step. Reheating can be accomplished prior to each succeeding step of the forming.

The production of complex integral parts by a combined extrusion-forging operation is not limited to the forming of turbine wheels and blades. By the employment of split extrusion dies within a forging die the forging field is immeasurably widened. Many parts that could not be made by any single forming method can be accurately and economically formed by a single procedure combining the two forming techniques.

Tapered Extrusion Designs

Interest in tapered extruded shapes has been prompted and encouraged by the specific requirements of the aircraft industry. The desirability of direct extrusion of a tapered section is evident from an examination of spars, caps, stiffeners and other structural aircraft parts.

In 1949, Reynolds Metals Co. executed a contract with the Air Materiel Command at Wright Field for the development of a method of extruding tapered shapes. A two-step method that was tried involved the extrusion of a hollow shape using tapered mandrels, followed by slitting the symmetrical extrusion lengthwise into two or more parts. The tapered extrusion shown in *Fig.* 9, made by this method, could be used as a tapered wing spar cap. Several tapered extrusions have been produced this way but the method has not yet been completely successful. It has been found that the flow of material during the extrusion process is insufficiently uniform to obtain consistent material properties. In spite of a great many experiments with different die designs, sections that consistently meet applicable specifications have yet to be produced. Further developments on this problem will be necessary.

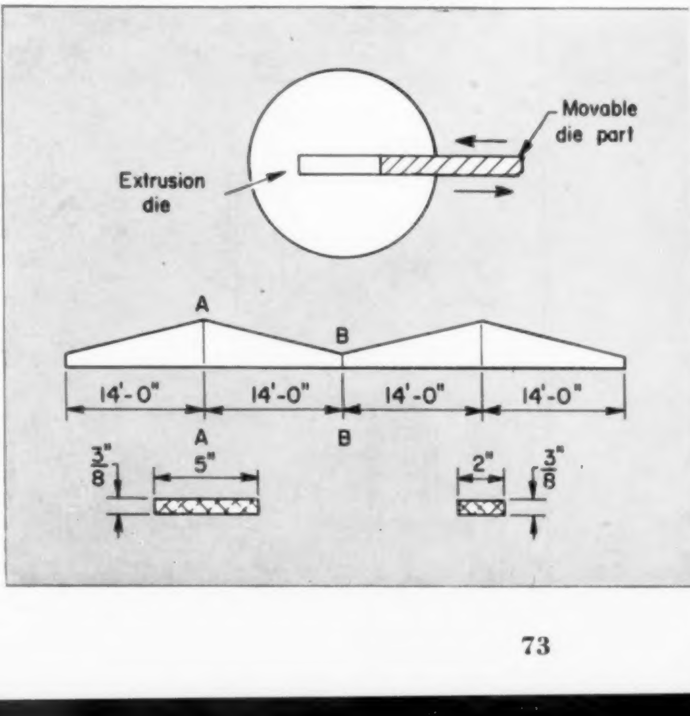
Another method of extruding tapered shapes was tried on a simple rectangular section in Germany during the last year of World War II. In the extrusion die, a movable part was used for opening or closing the rectangular die aperture as shown in *Fig.* 10. To avoid excessive pressure on the movable part, it was placed behind a steel bridge. About 50 extrusions with a maximum depth of approximately 2 inches and a thickness of 3/8 inch were delivered for the flange of a built-up wing spar cap used in the Messerschmidt airplane. Another shape, with thicker cross section, was produced as forging stock for tapered forged wing spar caps. Metallurgical investigation has shown that such shapes can be extruded with uniformly adequate properties in the high tensile alloys. Shown in *Fig.* 11 are two of many tapered configurations which could be extruded. Since no extrusion presses adaptable for this method are available at present this problem will be solved in the years ahead.

New Straightening Method

Die designs and the mechanical operation of an extrusion press are not the only problems in the development of new extrusion products. Prior to leaving the mill an extruded section is heat treated and quenched, detwisted and straightened by stretching, roll forming or drawing. The straightening of relatively wide sections of high-strength alloys has frequently been more of a problem than the actual extruding itself. Development of efficient straightening techniques has been of the utmost importance to the extrusion industry.

The aircraft industry has expressed a great deal of interest in obtaining integrally stiffened wing skin extrusions in widths of 30 inches or more, lengths of 40 feet and longer, and absolutely flat and straight.

Fig. 10. Simplified sketch of German tapered extrusion die (top) and typical tapered extrusion designed to be formed in it. Note movable die part.

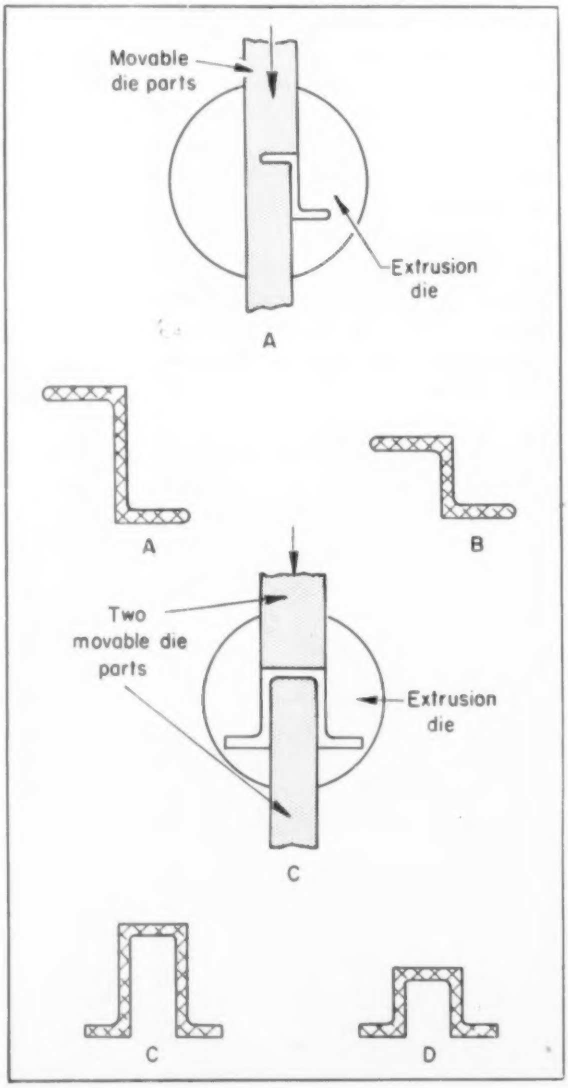


A method of extruding these shapes were developed by the company a number of years ago. The extrusion was a tubular form as shown in *Fig.* 12. The extruded tube is then slit from end to end, opened and flattened. After flattening, the section should be suitable for use in wing and fuselage surfaces of high speed aircraft.

The method employed in flattening these integrally stiffened skin sections were inadequate to provide the necessary degree of flatness required in aircraft; hence, the skin thickness of the extruded shapes was increased and the surface brought to final flatness by machining.

The machining operation was costly in both material and time; hence, efforts have continued toward the development of more perfect flattening techniques. A new flattening process, using a specially designed draw-straightening die has been developed to allow better straightening of integrally stiffened skin sections up to 30 inches in width. The work to date has been most promising and experimental work has progressed to its final stages. It is hoped that integrally stiffened skin extrusions will be produced to required flatness soon.

Fig. 11. Two typical dies and sections that could be produced in tapered extrusion dies using movable parts. Both the angle section (left) and hat section (right) are widely used in aircraft design.



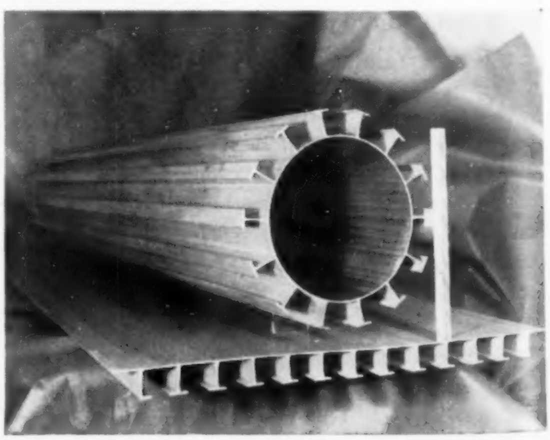
Since the working principle of this technique places no limitations on the width of material that can be handled, the production of integrally stiffened sections up to the maximum size of extrusion presses (approximately 60-inch width) will then be feasible. With the improved straightening technique, sections can be extruded to final thickness and a major part of machining operations can be eliminated.

Thin Wall Extrusions

Many design problems can be solved by extrusions with very thin wall thicknesses. The present extrusion technique using a forming pressure of 80,000–120,000 psi puts a limit on the minimum wall thickness of extrusions, depending on alloy and width of the shapes. New experiments have indicated that thinner walls can be obtained if the forming pressure is increased. With 200,000–240,000–psi pressure the present wall thicknesses may be decreased 30–60 percent, which will offer new design and application possibilities for aluminum extrusions, and increase their range of usefulness.

Development of extrusion techniques will continue in a number of interesting fields and paralleling this work must be the development of those supplementary operations that are so necessary to their practical application. While present applications for these complex extrusions have been largely in the realm of high-performance defense products, it can be confidently predicted that wide extrusions, thin wall shapes and combinations of extrusions and forgings will eventually replace many common commercial shapes that involve extensive processing and much scrap material.

Fig. 12. Tubular extrusion (top) has been developed to produce integrally stiffened surface (bottom) for aircraft use. Extrusion is slit and flattened after being extruded.



Scissors-Type Gage

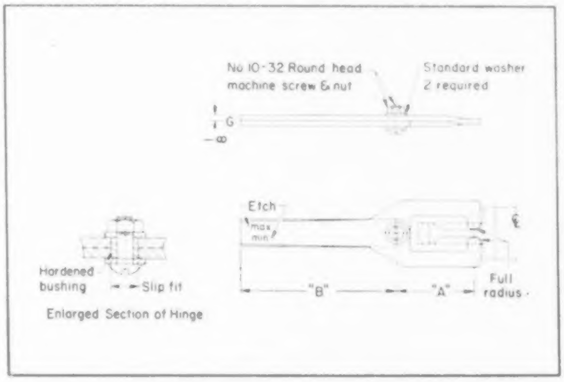
Checking thicknesses of recessed webs is often a problem, especially on production work, where inspection time is an important factor. The scissors-type gage design shown offers a simple and effective solution.

The two blades of the gage are made separately of gage steel hardened and ground, and then assembled for finish grinding of the gaging surfaces. Distance *A* depends on the size and shape of the workpiece to be gaged, of course, and must be such that adequate clearance is provided. Distance *B* should be at least twice distance *A* for best results.

The gage is set at maximum web thickness and the top surfaces of the two blades are ground flush. The bottom surfaces are ground flush with the gage set at minimum web thickness. The gage is finished by lettering "max" and "min" at the ends of the blades as shown.

In operation the dimension of the workpiece to be gaged is found to be within tolerance if the surfaces of the blades are flush or closer together on either "max" or "min" side, when the gaging fingers are contacting the two sides of the web. On the other hand, out-of-tolerance parts are spotted instantly by touch, since the ends of the scissors blades will be spread.

Henry C. Wojtowicz
Springfield, Mass. Chapter



Trim Die Template Eliminated

Deep dies in which metal shells are formed or stamped are often of irregular contour. The outline of the die edge where the sides meet the top face may also be an odd shape.

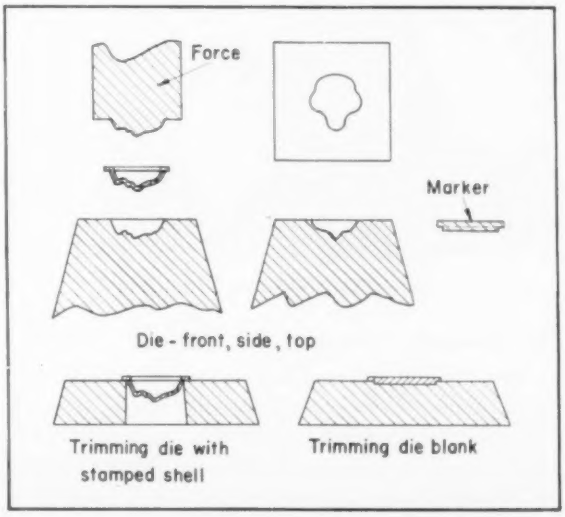
The sheet metal of which such parts are formed is usually pressed into the die by a male form, known in shop parlance as a "force." After stamping or pressing a border is usually left upon edge of the shell, which must be trimmed off.

The trim die to trim this border must have a shape which follows the exact outline of the edge of the form die. The common method of filing a template after pressing it into the form die, to get edge outline, and later carefully filing the trim die to fit the template, is tedious and painstaking. A simpler and more accurate method is described as follows:

A piece of soft annealed tool steel, 1/8 in. thick or over, is roughly shaped to the outline of the form die edge. It is then placed over the die, with some metal extending over the die edges on all sides. It is then pressed into the hard die with enough pressure to form upon the soft steel a sharp and distinct shoulder of the die outline. When this has been done the "marker" should be hardened.

There may be a slight bulge upon the face of the gadget after pressing on the shoulder. This should be ground flat leaving the pressed-on outline intact, with a sharply cornered edge.

The hardened marker is then placed on the



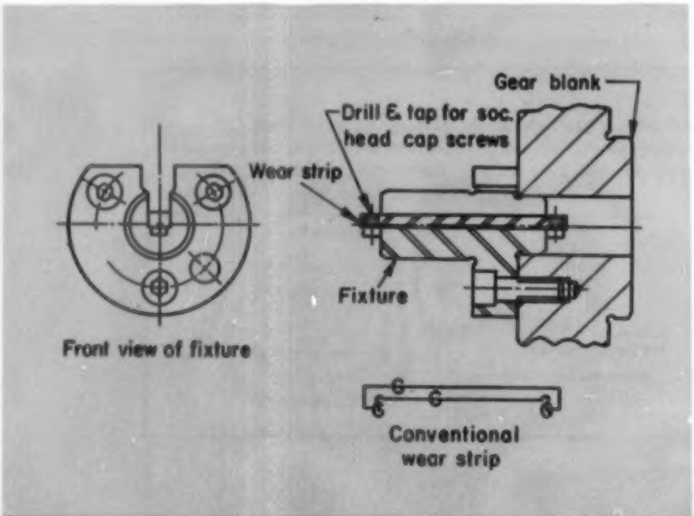
smoothly ground surface of the trim die blank, over the location of the die hole and pressed into the die blank. This should leave a sharply defined outline upon the die blank.

The trim die may now be roughed out from this outline and machined almost to the finished edge. When the marker is first pressed into the die blank there is a slight downward drag of metal around the marker edge which shows itself as a rounded edge upon the trimming die outline. This becomes more noticeable as the filing approaches the finish line.

After the die blank is roughed out, it should be ground on its top face to remove the rounded edge. The marker is then again pressed gently in. This improves the impression on the die edge, which now can be clearly seen in sharp outline. Careful filing will now bring a finished die edge to the exact outline of the forming die, thus eliminating the need for a template.

If it is desired to test the filed form for accuracy, a piece of sheet lead may be pressed into the form die, to outline its form, and then pressed into the trim die. Any high spots on the die will show up on the lead. The high spots may then be easily relieved.

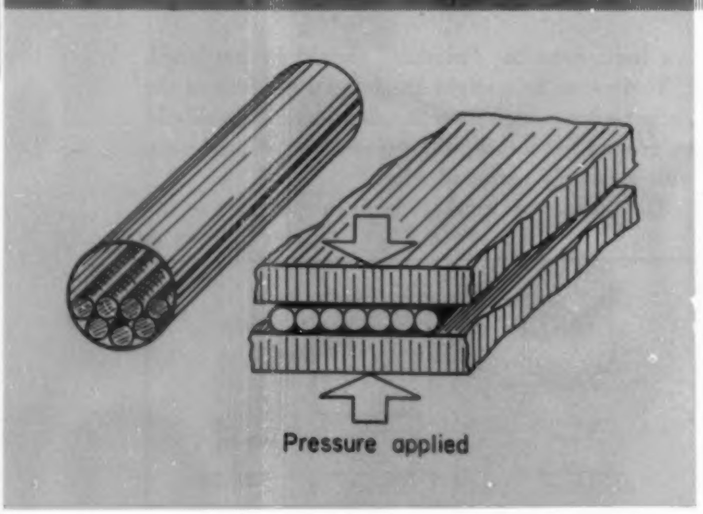
Frank E. Chace
Pawtucket, R. I.



Improved Broach Wear Strip

Considerable time is ordinarily consumed in cross machining and grinding conventional type wear strips shown in the accompanying illustration, for use in keyway broaching operations. This tool processing time can be eliminated by use of the design of wear strips shown in the broaching fixture. The new design consists merely of a flat strip drilled and tapped for socket head cap screws. The screws can be readily installed with sufficient accuracy and serve the purpose of holding the wear strip in position quite well.

Ernest Egger
Joliet Chapter



Method of Flattening Tubes

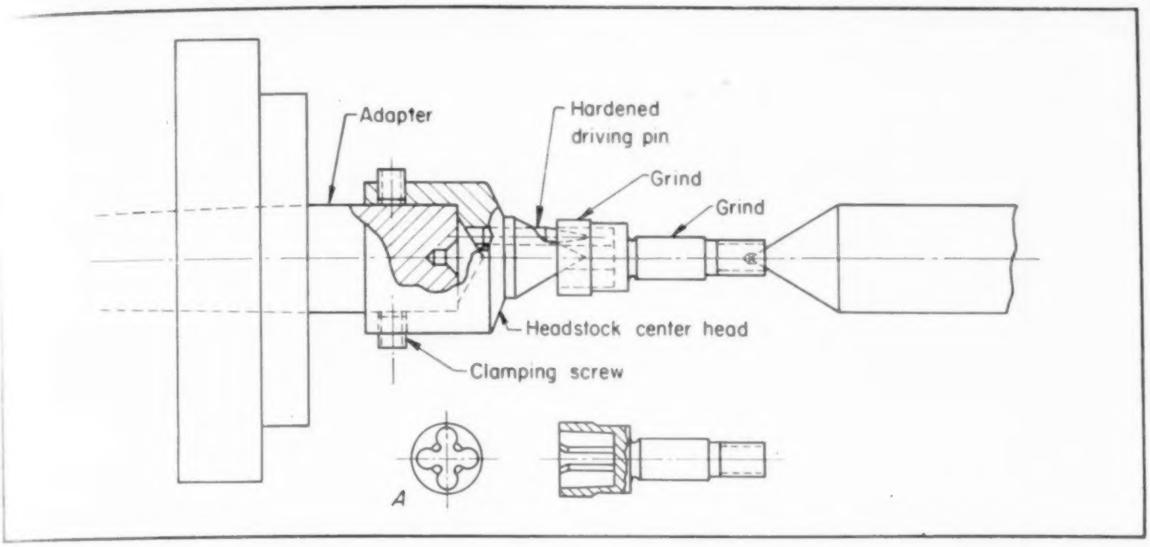
This method has been found simple and effective for flattening short pieces of tubing. A number of round iron bars or thick-walled tubes of small diameter and proper length are placed inside the tube. The tube to be flattened is then placed between two flat plates in a flywheel press. Gentle pressure is applied until the tube is brought to required shape. Some experimentation may be required at first to determine the number of small rods required.

Federico Strasser
Santiago, Chile

Headstock Center as Driver

Infeed grinding two diameters of a food blender shaft, shown in the accompanying sketch, created a problem. The small production rate prohibited purchase of a centerless grinder, so the job had to be performed on a universal grinder. The main difficulty encountered was that the head end of the shaft could not be ground if driving dogs were used.

This difficulty was overcome by means of a special headstock center head, which was mounted



first on a standard headstock center for a trial run. Later the hardened and ground adapter shown in the sketch was made. The tapered shaft adapter is made to fit accurately into the bore of the headstock center head and is clamped by setscrews. It is possible to change the head on the adapter if it is necessary and grind the point in place on the grinder.

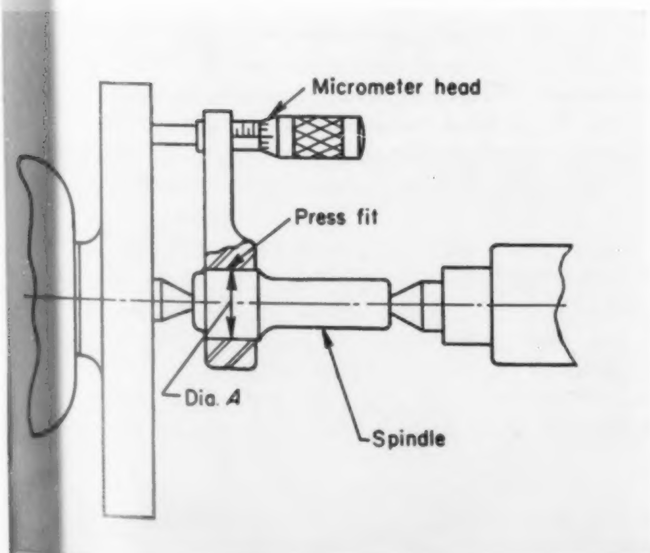
The hardened headstock center head with the previously drilled and reamed hole for the driving pin is pushed into position on the adapter and clamped by the setscrews. After the point has been ground, the hardened driving pin is driven into the reamed hole of the head. Now the headstock center is ready for use.

The driving pin can have a tapered point as shown or it could be flattened to engage small slots in a workpiece. Other adaptations are also possible. The slotted heads of the parts are center reamed after engaging impressions or slots have been made. This device has proved practical in production, having been used successfully for more than a year.

Paul Forberger
San Paulo, Brazil

Tailstock Alignment Tool

While there are many methods for checking the alignment of tailstock center with the headstock center of an engine lathe, the device illustrated is quicker and more accurate than most methods in common use.



A micrometer head is mounted into an arm which has been press fitted onto a hardened and ground arbor. By taking measurements on the front and back side of a true faceplate, any error in alignment can be detected and corrected easily. If the tailstock is off center, the micrometer will give different readings when rotated 180 deg. The center holes in this hardened and ground arbor should be carefully lapped before grinding as the center holes must be precisely aligned. It is also essential that the faceplate be perfectly trued. The spindle should be hardened to 60 Rockwell *C* and diameter *A* ground on centers. This micrometer head is more foolproof than a dial indicator mounted on the arm.

H. J. Gerber
Member-at-Large
Stillwater, Okla.

How to Machine Titanium

By H. Jack Siekmann

Design and Application Engineer
Carboloy Dept.
General Electric Co.
Detroit 32, Mich.

Machining titanium and its alloys will always be a problem no matter what techniques are employed to transform this metal into chips. Most of the problems seem to stem from inherent characteristics of the metal itself and from conditions created during actual machining. A closer look at what happens when machining steel and similarly easy-to-shear materials through the use of cutting tools may help considerably in understanding the behavior of titanium.

In machining titanium, *Fig.* 1, a chip is produced which runs across the top of the tool at a speed two to three times faster than occurs when machining steel. Tool-chip interface temperatures up to about 2000 F are produced at a pressure of 200,000 to 300,000 psi. All this takes place on an area about half as large as in machining steel and on a material that, under these conditions, has an extreme tendency to dissolve anything that comes in contact with it. Further complicating the picture are less obvious factors such as a relatively low modulus of elasticity compared to cutting forces in machining and the periodic vibration of the chip formation.

It has been pointed out by several authorities that the closely packed hexagonal-crystal system of titanium affords a limited number of slip or shear planes. Therefore, crystal orientation has a marked effect upon the shear angle and thus upon the thickness of the chip. As a tool machines the outside diameter of a bar, assuming the crystals in a round bar are oriented in approximately the same direction, the slip planes of the crystals available to shear vary every 90-deg revolution. This shifts the shear angle, the resultant variation and the thickness of the chip every quarter turn, and tends to set up pulsating pressures on the workpiece and cutting tool.

As a ⅝-inch depth of cut was taken on a large billet of titanium alloy, chips were formed which showed the effect of the crystals on the shearing action. As can be seen in *Fig.* 2, the crystal structure caused the chip formation to vary as the tool passed through each crystal producing a similar pattern on top of the chip. The two sections of the

Fig. 1. Heavy roughing cut on a forged titanium disk. Chips shown in *Fig.* 2 were taken from similar cut.

ble 1—**Physical Properties of Cutting Tool Materials**

ool Material	Compressive Strength (psi x 10³)	Hardness (R$_c$)	Thermal Conductivity (Cal/cm²-sec-C/cm)
arbide	790	80	0.19
st Alloy	340	60	(Low)
gh-Speed Steel	600	64	0.06
gh-Carbon Steel	230	62	0.11

hip were taken at 90-deg intervals in the rotation of the workpiece and show the change in the size of the pattern produced.

This condition normally might be no problem but, since the tool loads are in the same order of magnitude as those found in machining steel and the modulus of elasticity or the stiffness of the titanium and its alloys are about half that of steel, the result is twice the deflection of the workpiece for a given size of cut. Pulsation of these large deflections will cause chatter or vibration unless the workpiece is well supported and the machining setup is rigid. This adverse condition is not always noticeable as the cause of tool failure.

This effect of crystal orientation on cutting forces has come to light in a different manner in machining thin sections with large grain size. The crystals within the grains have different orientation from grain to grain and, when these approach ¼ to ⅜-inch mean diameter, the resultant fluctuation in cutting forces on the tool as it passes from grain to grain causes the work or tool to move in and out. The variation in depth of cut brings about a rough surface on the workpiece and may hasten tool failure. Rigid backing up of the workpiece, as well as solid mounting of the tool, will reduce roughness of the piece and possibly reduce tool failure. Reduction of grain size in the titanium workpiece is the most promising way of eliminating this condition.

Early in the use of titanium for industrial applications, it was felt that these newly observed difficulties presented an almost unsurmountable barrier in attempts to fabricate parts of this material. Carboloy joined many other groups in attacking the growing pains of this new "wonder metal." After a year or so of development and design, the basic problems of machining titanium are better understood. Now titanium can be fabricated into parts with some degree of confidence.

In selecting a tool to combat these problems, a material must be found that will resist the erosion effect of this high-speed chip and have good physical properties at these high temperatures. A material is sought that will be able to dissipate heat and have high compressive strength to resist the deformation of bearing pressures in the order of 200,000 to 300,000 psi. The properties of cast alloy, carbide, high-speed steel and high-carbon steel are compared in TABLE 1.

The high compressive strength, high hardness and good thermal conductivity of carbide tools enable them to resist the excessive deformation pressures, reduce the effect of the increased speed of the chip and do a better job of carrying away the heat generated by the high tool chip interface temperatures.

These data are for room temperature. Relative physical properties at elevated temperatures are shown in *Fig.* 3. From this comparative information, it can be seen that, of the commonly used tool materials available today, tungsten carbide has the best chances of machining titanium successfully. Actual experience has proved this to be true.

Within the field of carbides, there are also varying physical properties to be considered, TABLES 2 and 3 and *Fig.* 4. Grades of carbide containing

Fig. 2. (below) Titanium alloy chips taken at 90-deg intervals, ⅝-inch depth of cut. Magnification one and one-half.

Fig. 3. (right) Hardness of common tool materials at various temperatures.

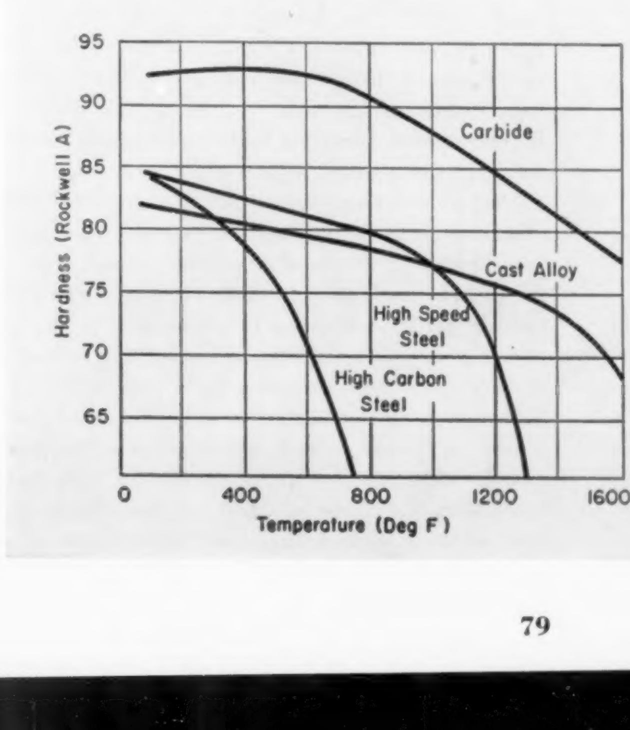


Table 2—Physical Properties of Carbides

Cutting Type	Composition %	Transverse Rupture (psi)	Thermal Conduct'y (cal/cm²-sec-C/cm)	Mod. of Elasticity (psi x 10⁶)	Fatigue Strength* (psi x 10³)
Steel	TiC + WC + 6Co	177,000	0.09	77	80
Cast Iron	WC + 6Co	234,000	0.19	88	105

*Fatigue strength at 20 x 10⁶ cycles.

Table 3—Compression of Carbides at Elevated Temperatures

Temperature	Percentage Compression Under 14,220 psi: Cast Iron Grade*	Steel Cutting Grade†
1110 F	0	0
1650 F	0	0
1830 F	0.3	0.1
2010 F	1.8	0.8

*Cast iron grade containing WC + 6%Co.
†Steel cutting grade containing TiC + WC + 6%Co.

appreciable amounts of titanium carbide are generally typed as steel cutting grades. Those mainly consisting of tungsten carbide and cobalt are typed as cast iron cutting grades or nonferrous cutting grades. The fact that cast iron grades have higher thermal conductivity enables them to conduct the heat away from the tool-chip interface more readily than the steel grades, which lowers the temperature in the vicinity of the tool-chip interface.

The high transverse rupture strength and modulus of elasticity enables the cast iron grades to withstand higher loads on the cutting edge without breaking as well as being stiffer and more rigid. The high fatigue strength of cast iron grades enables them to withstand the rapid fluctuation of tool forces experienced in machining titanium.

In *Fig.* 4 it can be seen that the straight tungsten carbide grades retain their higher hardness at elevated temperatures. TABLE 3 shows that the compressive strength of the steel grades is not significantly higher than the cast iron grades until temperatures over 2000 F are reached. Since the tool-chip interface temperature is only present on the extreme top surface of the carbide tip, it is doubtful if compression failure at high temperatures should influence the type of carbide grade to be used.

Due to the high chemical affinity of titanium with other materials at the high temperature and pressure present in cutting, the chemical composition of the carbide grade is important. Tests indicated that carbide grades containing titanium carbide have a higher tendency to dissolve in, and weld to titanium than do the straight tungsten carbide grades. Furthermore, cobalt, as well as other binding materials sometimes used to cement carbides such as iron and nickel, will dissolve quite readily in titanium. Laboratory tests have substantiated this. Since carbides contain binders, the object is to use as little

Table 4—Carbides Recommended for Machining Titanium and Titanium Alloys

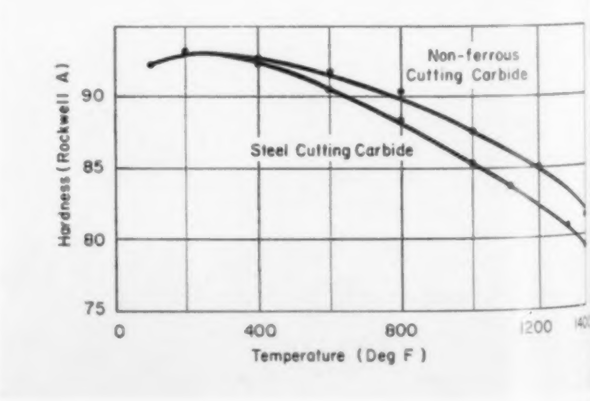
Carbide Grade Designation: Industry	Carboloy	Hardness (Rockwell A)	Transverse Rupture Strength (psi x 10³)
C-4	999	92.6	175
C-3	905	92.1	200
C-2	883	92.0	215
C-1	44A	91.0	230

binder as possible and still maintain enough strength in the cutting edge. Actually, as is well-known, almost all materials react with titanium at high temperatures, necessitating the selection of a material which has the least tendency to do this. The straight tungsten carbide or cast iron grades are the best answer to this problem, TABLE 4. [A more complete chart of equivalent carbide grades appears on page 117 of this issue. Ed.]

One major exception to this finding has been the successful application of Carboloy grade 370, a heavy-duty grade for machining steel for scalping rough titanium billets. Low turning speeds of 25 to 50 fpm and feeds around 0.025 ipr do not produce the high tool-chip interface temperatures experienced at 100 to 200 fpm in normal titanium machining. Therefore, the chemical composition of the tool material is less critical and the ability of the cutting edge of grade 370 to withstand the severe impact of the irregular surfaces and the abrasion of the scale is important.

Variation in the titanium or titanium alloy being machined often causes greater changes in tool life than can be achieved by changes in tooling. Many such difficulties have been overcome by improved methods of titanium manufacture but new problems develop periodically. One of the better known metallurgical problems that seriously affects the machining of this material is a high percentage of carbon, oxygen or nitrogen. The carbon content

Fig. 4. Effect of temperature on hardness of steel cutting and cast iron grades of carbide.



hould be kept below 0.2 percent. Amounts higher than this make titatnium extremely difficult to machine at any speed. Even variations in carbon content below this figure produce noticeable variation in machinability.

Work materials where the hardness goes above R_c 37-38 become difficult to machine. Difficulty has also been encountered in taking light finishing cuts on fairly soft material. A titanium alloy workpiece having a R_c 36 was being finish machined at 90 fpm, 0.008 ipr and 1/16-inch depth of cut. At this low speed, tool life was long. When the same alloy was machined at R_c 30 tool life on the finishing tools dropped to zero, although the roughing operation was unaffected. Excessive build-up on the cutting edge seemed to be the problem. Surface speed could not be increased appreciably. Only through the use of free cutting angles, 15-deg side rake and 10-deg back rake, and a good flood of coolant could good tool life be obtained.

It is now clear that work hardening in titanium does not seriously affect machining the metal. Tools have been known to fail completely on a surface without appreciable work hardening. When new tools were inserted the same surface was machined without difficulty.

Unless surface scale formed in forging is cleaned off, it will have an extremely abrasive effect on the cutting edge of the tool. Because the scale contains titanium carbide, titanium nitrate and titanium oxide (some of which are used in cutting tools and grinding wheels) this effect is understandable.

Carbide Grades Recommended

The purpose of the program which produced the following data was to establish a guide as to what grades should be used in machining titanium and titanium alloy. The material, Ti-150-A, was supplied by the Watertown Arsenal. Also, the effect of speed, feed and coolant was determined. The tool life tests were run on an engine lathe, with tool life based on a 0.020-inch wear land on the flank of the tool. Due to a scarcity of work material, the tests were limited to a short-life test of about 30 minutes. The tool shape used was 0 deg back rake, 5-deg side rake, 12-deg end clearance, 12-deg side clearance, 7-deg end cutting edge angle, 45-deg side cutting edge angle and a sharp nose.

Tool life of a general-purpose steel-cutting grade, grade 370, is compared in *Fig.* 5 with that of a cast iron or nonferrous cutting grade, grade 883, recommended for average cutting conditions on titanium. The latter grade, under these conditions, is superior to the steel-cutting grade. As mentioned previously, this was not the case in rough, scaled, interrupted cuts at slow speeds where the steel-cutting grade withstands the punishment better.

A harder, less tough finishing grade, number 905, is compared in *Fig.* 6 with grade 883. Under the semiroughing test conditions, the finishing grade failed due to minute chipping, giving lower tool life. Chipping is an everpresent problem in machining titanium, although under favorable conditions the harder finishing grades will give extended tool life. When these grades are used, however, premature failure of the tool always raises the suspicion of minute chipping as the cause.

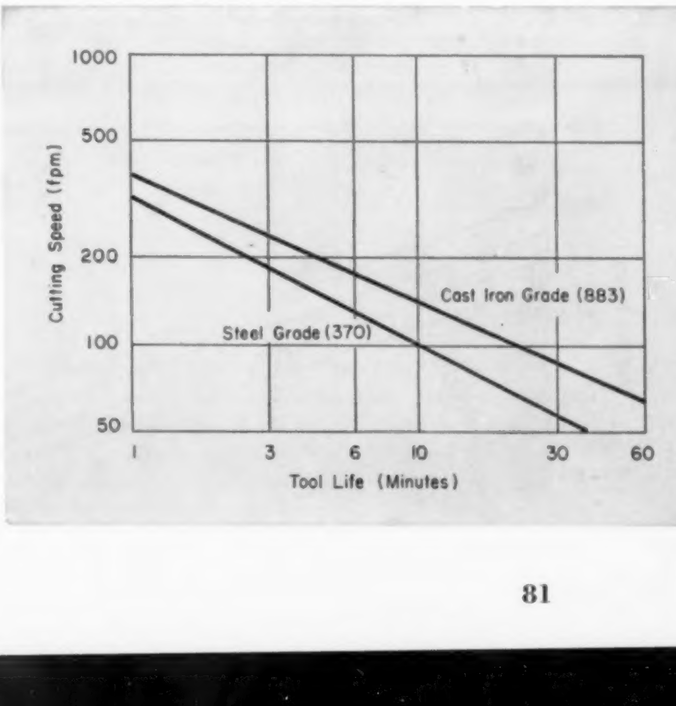
Under conditions of a lighter cut, the extremely hard finishing grades such as grade 999 give exceptional tool life. Under practically all cutting conditions, as well as finishing cuts, good finishes can be obtained easily.

Increasing the feed has a definite tendency to reduce tool life, *Fig.* 7. In fact, under conditions of the test, reduction in the tool life is so great that increasing the feed even reduces the cubic inches of metal cut per tool grind in the heavier feed ranges. The optimum feed for the greatest material removed per tool grind, seems to be between 0.008 and 0.0013-inch feed per revolution. Of course, in roughing operations it may be economical to sacrifice some tool life to get the pieces machined more rapidly.

Some tests were made to determine the effect of coolant on tool life. Resulting data are somewhat limited due to material restrictions. Some indication of trends, however, can be derived.

The results indicate that under the slower speed conditions (250 fpm) both CO_2 and synthetic soluble oils give an improvement over cutting dry, but the soluble oil gives longer tool life than CO_2. At higher speed (500 fpm) and associated higher tool-chip interface temperatures CO_2 allowed the tool to run longer before the nose of the tool wore

Fig. 5. Cast iron cutting grades are superior to steel cutting grades for machining titanium alloy at 34-R_c. Feed was 0.015 ipr, depth of cut 0.100-inch.



0.002 inch, while the soluble oil aided the tool to resist wear on the flank of the tool for a longer time.

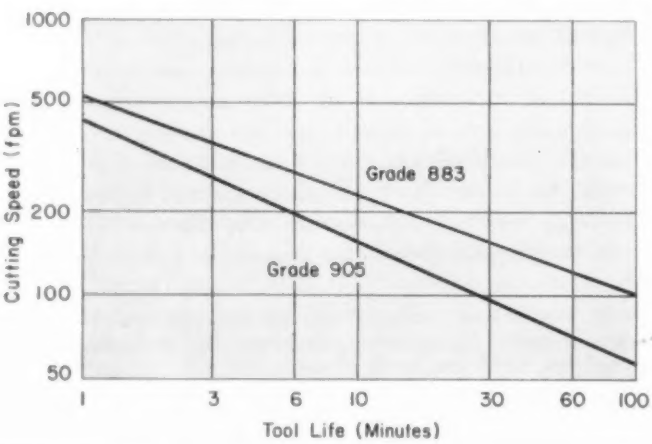
Based on present information, the following are recommendations for turning, boring and facing alloyed titanium materials. If commercially pure material is to be machined speeds can be approximately doubled.

1. *Rough machining of irregular scaled material:* For these highly abrasive cutting conditions, the surface speed should be in the range of 25 to 60 fpm. Grade 370 will perform well at these slow speeds. If the surface is fairly regular and speeds can be increased, grade 44A should give good tool life. The nose of the tool should be kept below the surface scale at all times. Maximum depths should be taken. Extreme honing of the cutting edge will help the cutting edge withstand the interrupted impact cutting conditions. Feed may be varied between 0.015 and 0.025-inch per revolution, depending on the rigidity of the machine tool used. Good results have been obtained with a standard B-style carbide tool (15-deg SCEA, 8-deg ECEA, 6-deg SR, 0-deg BR, 7-deg side and end clearances, 1/32-inch NR) with fairly large-sized shank cross sections.
2. *Roughing and semifinishing cuts on material with little or no surface scale present:* Grade 883 will give reasonable tool life for most average cuts at about 150 fpm feeds from 0.010 to 0.020-ipr and depths of cut up to 1/8-inch. These heavier cuts should only be taken with rigid setups on heavy machine tools. Again, honing the cutting edge may be necessary if minute chipping of the cutting edge is encountered.
   Both triangular and ½-inch diameter round insert tools give good results, especially where rigidity is no problem. For less rigid conditions a B-style tool modified slightly as follows should give less tool pressure and freer cutting: 5 to 7-deg side rake, 0-deg back rake, 45-deg side cutting edge angle, 5-deg end cutting edge angle, 10 deg on side and end clearance angles, 0 to 1/16-inch nose radius.
3. *Finishing:* Grade 999 gives excellent surface finish and reasonable tool life at 300 fpm on light finishing cuts. Grade 905 can be used to eliminate chipping of the cutting edge if it is encountered. On especially nonrigid tooling conditions or heavy finishing cuts, grade 883 will give good finishing results but at a somewhat lower speed. Feeds from 0.005 to 0.010 ipr and depths of cut of 1/64 to 1/32-inch should be used.

Round or triangular inserts should be used or a B-style tool with 10-deg side rake, 5-deg back rake, 45-deg side-cutting edge angle, 8-deg end cutting edge angle, 10 deg side and end clearance angles, 0 to 1/32 inch nose radius. A good stream of coolant may be necessary to stiffen the thin titanium chip on these light cuts to keep it from building up on the cutting edge.

Milling titanium alloy has been a difficult problem in many cases. Climb type face milling gives the best results. Every effort should be made to thin the chip as the cutter teeth leave the work material. This reduces the tendency of the chip to stick to the face of the carbide tooth and bring about chipping when the chips are knocked off the next revolution. Light feeds between 0.002 and 0.003-inch per tooth will also help. Grade 883 should be used with tool angles of 0-deg axial, and 0-deg radial rakes, 10-deg to 12-deg relief angle, 3-deg face cutting edge angle, 45-deg peripheral cutting edge angle, 3-deg face cutting edge angle, 45-deg peripheral cutting edge angle or chamfer and a sharp nose. No coolant is recommended. Care should be taken to determine whether excessive wear is due to minute chipping in the early stage of tool wear. Small amounts of this type of wear are permissible but it should be realized that it is not due to the carbide being too brittle. In milling commercially pure titanium, the problem of chip sticking is reduced and feeds may be increased to about 0.005-inch per tooth.

These recommendations for machining titanium and titanium alloys are intended as a guide from which individual experience can be developed to suit specific production conditions.



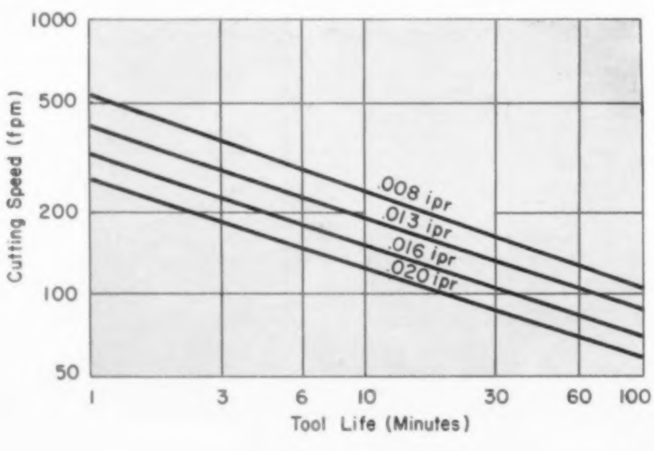


Fig. 6. (top) Tool life for semi-roughing cuts with finishing grades 883 and 905. The latter shows reduced tool life due to chipping. Test was performed on Ti-150A with Grade 883 carbide, without coolant. Depth of cut was 0.100-inch, feed 0.008 ipr, tool shape: 0,5,12,12,7,45.

Fig. 7. (left) Tool life at various feeds. Tool shape and test conditions were the same as for *Fig. 6*.

AVOIDING TOOL FAILURES

with negative rake

By Max Kronenberg*

Consulting Engineer
Cincinnati, Ohio

ALTHOUGH IT HAS BEEN KNOWN for some time that failures in carbide tools could frequently be avoided by the use of negative back rake, the reasons for this better performance have not been satisfactorily explained. By mathematical analysis of the various forces, the true reasons are understandable and the developed formulas can serve as a guide to future tool design.

Improvement in the performance of tools with negative rakes is sometimes explained by referring to sketches such as shown in *Fig.* 1. It is assumed that the cutting forces act normal to the tool face and it is claimed that the tool with negative rake is stronger because it can withstand such application of force better than the tool with positive rake when the forces are high enough to bend the tip. Carbide is weak in tension and will crack if overstressed.

These sketches do not represent the true conditions because the friction force acting along the tool face is disregarded. Such oversimplification leads to faulty conclusions. It neither explains the appearance of cracks in carbide tools nor offers means for avoiding them.

It has been indicated in a recent article by the author[1] that the friction force, which acts tangentially to the tool face, can often be larger than normal force. Omitting the effects of such a large factor makes any conclusions meaningless. The normal force and the friction force, which together form the cutting force resultant in a two-dimensional system, must be considered when analyzing the reasons for cracks in tool tips. The resultant force, because of the friction component, never acts perpendicular to the tool face as implied in *Fig.* 1. Effects of heat can be neglected because they are of a different nature, not associated with this analysis. Also, it is assumed that the resultant cutting force is concentrated at the apex, as usual.[2]

Stresses in a Wedge

In order to investigate the stresses generated in a tool face, it is feasible to first consider stresses in wedges. Because the mathematical analysis of wedges has been completed by J. H. Mitchell,[3] it is unnecessary to repeat them here. The equation derived for wedges in general can be applied to tool wedges if properly modified.

The sketch in *Fig.* 2 represents a wedge with a force P_a applied at the apex in a direction to bisect the wedge. Through the use of polar coordinates and calculus, Mitchell derived the following equation for stress generated in any radial direction in this wedge, as indicated by the arrows at the broken end:

$$s_{ra} = \frac{2\ P_a \cos \varepsilon}{r\ (\beta + \sin \beta)} \qquad (1)$$

This equation applies to a geometrical triangle with a sharp apex. Cutting tools have ground radii instead of apexes and a study of Equation 1 shows why. By considering a point at the apex where $r = 0$ it can be seen that the stress would be infinite

*Senior member ASTE Cincinnati chapter.

[1]References are tabulated at end of article.

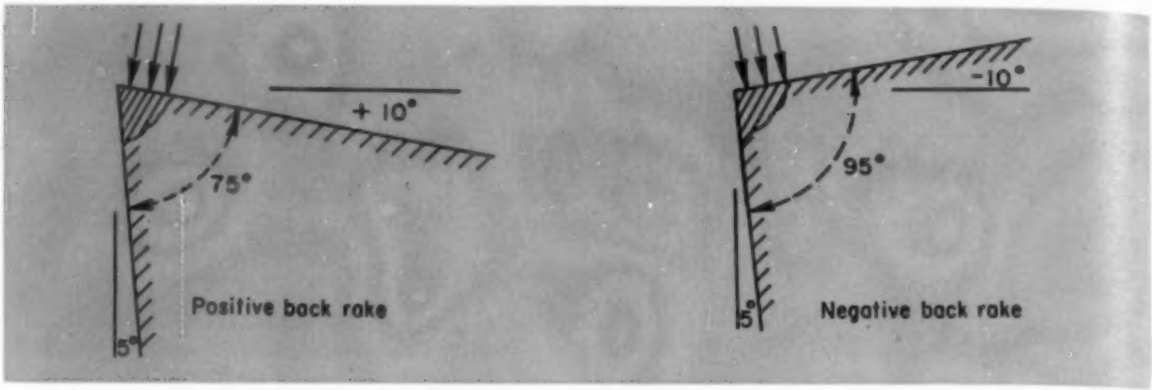


Fig. 1. Inadequate representations of cutting force action on cutting tools with positive and negative true rake angles. They neglect friction.

and break-down of the point would be immediate. Since tools have rounded noses, this article will therefore treat only the conditions at the actual cutting edge.

Continuing the analysis, a different case of a force applied to a sharp-pointed wedge is shown in *Fig.* 3. In this instance, the force is applied to an angle

Nomenclature

F	= Friction force
N	= Normal force
R	= Resultant cutting force
P_a	= Force bisecting a wedge at its apex
P_b	= Force at right angle to wedge bisector
r	= Polar coordinate, radial distance
s_r	= Radial stress generated at any point, except nose, in a tool wedge
s_{ra}	= Radial stress generated in wedge bisecting force
s_{rb}	= Radial stress generated in wedge by force perpendicular to bisector
s_{rt}	= Radial stress in the tool face
α	= True rake angle
β	= Included angle of wedge
γ	= Angle between cutting force resultant and wedge bisector
γ_{max}	= Angle of cutting force resultant to wedge bisector that causes zero radial stress in tool face
ε	= Polar coordinate, angular displacement
ω	= Angle included between tool face and resultant cutting force
ω_{max}	= Angle of cutting force resultant to tool face that causes zero radial stress in tool face

of 90 deg to the bisector of the wedge. Under these conditions, the formula for the radial stress at any point in the wedge is:

$$s_{rb} = \frac{2\,P_b \sin \varepsilon}{r\,(\beta - \sin \beta)} \quad \cdots\cdots (2)$$

Stresses in Tool Wedges

In metal cutting, the resultant force acting on the tool can be at various angles to the bisector of the wedge, depending on the sizes of the normal and friction force components. Equations 1 and 2 must therefore be adapted to suit the conditions existing with tools.

The general case of a tool wedge acted upon by a resultant cutting force is illustrated in *Fig.* 4. The resultant acts in an arbitrary direction at an angle of γ from the wedge bisector. The resultant cutting force can be resolved into two components as follows:

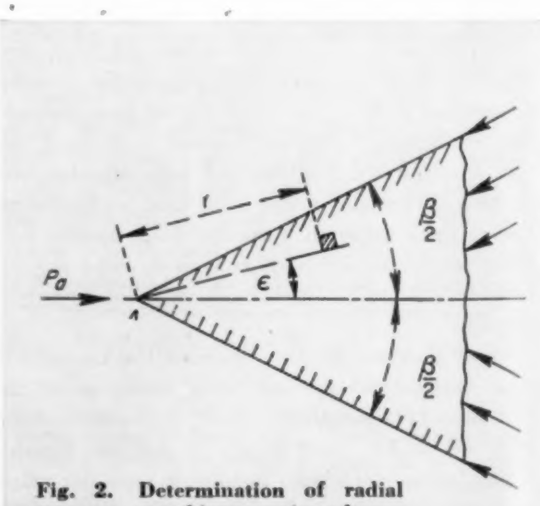


Fig. 2. Determination of radial stress at an arbitrary point when a force is applied along the wedge bisector.

$$P_a = R \cos \gamma \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$P_b = R \sin \gamma \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The radial stress generated at any arbitrary point in a tool can then be obtained by superposition of the two stresses due to the two components. This is done by substituting Equations 3 and 4 into Equations 1 and 2, respectively, and adding them. The result is as follows:

$$s_r = \frac{2R}{r}\left(\frac{\cos \varepsilon \cos \gamma}{\beta + \sin \beta} + \frac{\sin \varepsilon \sin \gamma}{\beta - \sin \beta}\right) \ldots\ldots (5)$$

This equation can be used for calculation of the radial stresses generated at any point within a wedge-shaped tool, except at the tool nose, for any direction of cutting force resultant and for any magnitude of the included angle of the tool.

Stresses in the Tool Face

Since the stresses generated in the tool tip or at the tool face are of primary interest when trying to determine conditions that cause cracks in carbides, Equation 5 can be simplified so that it applies only to the stresses in the tool face. The angle $\beta/2$ must have a positive sign when calculating stresses in the tool face and a negative sign for calculation of stress in the other half of the triangular wedge. For the tool face:

$$\varepsilon = \frac{\beta}{2}$$

and

$$s_{rt} = \frac{2R}{r}\left(\frac{\cos\frac{\beta}{2}\cos \gamma}{\beta + \sin \beta} + \frac{\sin\frac{\beta}{2}\sin \gamma}{\beta - \beta}\right) \ldots\ldots (6)$$

The stress in the tool face will be zero (neither tension nor compression) when Equation 6 equals zero. It is obvious that Equation 6 will be zero if the resultant cutting force R is zero. Another solution is obtained by making the term in parentheses zero, which is the case when:

$$\frac{\sin \beta/2 \sin \gamma}{\beta - \sin \beta} = \frac{\cos \beta/2 \cos \gamma}{\beta + \sin \beta} \ldots\ldots\ldots\ldots (7)$$

Since it is of most interest to determine the direction of the resultant cutting force that would cause zero stress in the tool face, Equation 7 is solved for a function of the angle of the resultant cutting force, or:

$$\tan \gamma_{max} = - \cot \frac{\beta}{2}\left(\frac{\alpha - \sin \beta}{\beta + \sin \beta}\right) \ldots\ldots\ldots (8)$$

This equation is important because it affords an opportunity to the tool engineer to relate specific tool designs to optimum conditions. If the angle γ resulting from a specific speed, feed, etc., is greater than that indicated by Equation 8, there will be tension in the tool face, which is undesirable with carbides. If the actual angle is smaller than that indicated by Equation 8, the tool face will be under compression, which is desirable.

The accompanying table his been prepared by use of Equation 8 to indicate the direction of the cutting force resultant that would give zero stress in the tool face for included angles from 45 to 110 deg. True rake angles were obtained by assuming a clearance angle of 5 deg. The angle $\varphi_{max} = \beta/2 + \gamma_{max}$ as shown in *Fig.* 5 and tan φ_{max} is equal to the magnitude of the friction force. When tan φ_{max} is less than 1, the normal force must be

Fig. 3. Determination of radial stress at an arbitrary point when a force is applied perpendicular to the wedge bisector.

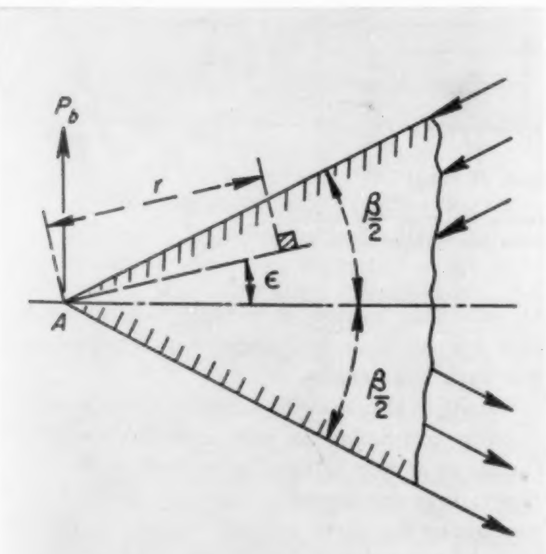
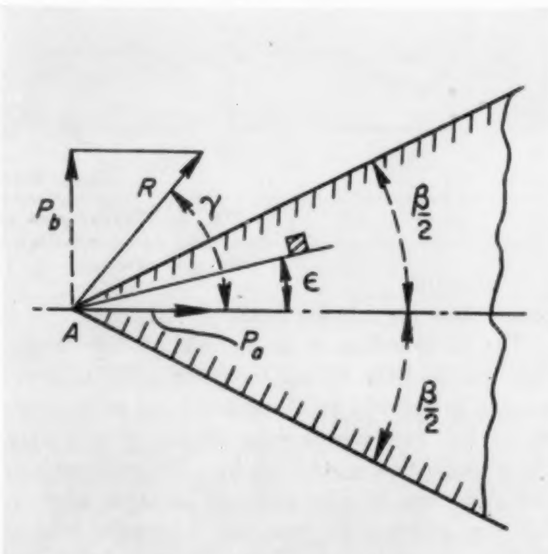


Fig. 4. Determination of radial stress at an arbitrary point when a resultant cutting force acts at an arbitrary angle to the wedge bisector.



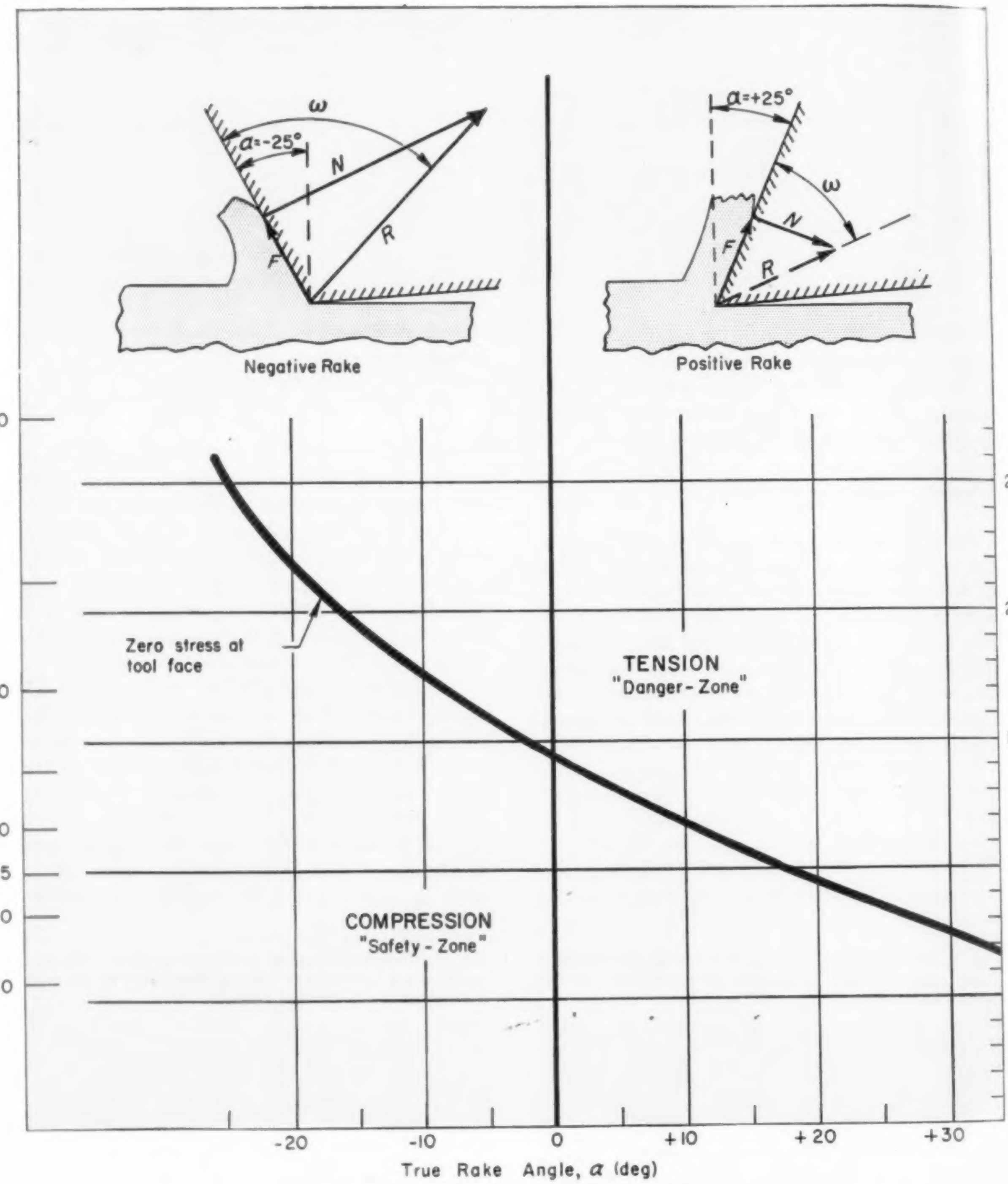


Fig. 5. Danger and safety zones indicate the conditions for generation of tension or compression in the tool face.

larger than the friction force.

The table indicates, as an example of its use, that the resultant cutting force—in order to avoid tension in the tool face—must not act at an angle to the tool face greater than 29 deg 40 min when the included tool angle is 45 deg. The resultant may act at 68 deg 30 min when the included angle is 110 deg, which is the case with a negative rake of 25 deg. It can be seen from this that the chance of generating tension in the tool face is considerably less for tools with negative rather than positive back rake angles.

Results of this analysis are even easier to understand by calculating the ratio of normal to friction forces, as shown in the last column of the table. This ratio is represented by the curve in *Fig.* 5. The area above the curve indicates tension in the tool face and represents a danger zone. The area under

he curve indicates compression and is generally safe. The ratio might be correct to prevent formation of cracks under normal conditions, but cracks could form if the forces were sufficiently large.

Since it has been found that friction force does not change substantially (often, it does not change at all) when the true rake of the tool is changed, it can be assumed with reasonable accuracy that the friction force remains constant for the values shown in the table. This means that the normal force may increase rapidly, with decreasing true rake, without causing tension in the tool face. For the extreme case of a change from a true rake angle of +45 deg to one of −25 deg, the normal cutting force may increase 2.56/0.57 = 4.5 times, or 350 percent, without causing tension in the tool face.

Negative true rake angles make possible use of considerably higher cutting forces than positive rake angles because tension in the tool face, which destroys carbides rapidly, can more easily be avoided. More data on the permissible increase in normal forces can be obtained from the last column in the table by comparing various true rakes.

Actually, the cutting force does not increase at the rate that is permissible, when using negative rakes. A good over-all value for the increase in cutting force is about 30 percent for a change from +15 to −15 deg true rake, while an increase of 93 percent ([1.97-1.02] ÷ 1.02) would be admissible. The load carrying capacity of a single-point cutting tool, as far as stresses at the tool face are concerned, increases considerably faster than the cutting force when changing from positive to negative rakes.

Conditions Giving Zero Stress in Tool Face

True Rake Angle α (deg)	Included Tool Angle β (deg)	For Zero Stress in Tool Face: Direction of Resultant R: γ_{max} (deg)	ω_{max} (deg)	Maximum Ratio of Normal to Friction Forces $\tan \omega_{max}$
+40	45	7° 10′	29° 40′	0.570
+35	50	7° 50′	32° 50′	0.645
+25	60	9° 25′	39° 25′	0.824
+15	70	10° 30′	45° 30′	1.02
+ 5	80	11° 45′	51° 45′	1.27
− 5	90	12° 30′	57° 30′	1.57
−15	100	13° 5′	63° 5′	1.97
−25	110	13° 30′	68° 30′	2.56

It should be noted that angle ω included between the tool face and resultant cutting force is often greater than the maximum value indicated in the table. When this angle is larger than permissible, tension is caused in the tool face and poor tool performance can result.

In the event that angle ω becomes larger than the included angle β (a condition that can only occur when the sum of angle β and the clearance angle equals 90 deg or less), the resultant force R is no longer directed into the tool but tends to push the tool onto the machined surface. The force triangle would no longer be "cantilevered", as in the foregoing mathematical discussion but would be supported by the workpiece. This would lead to different equations and additional conclusions.

As a result of the foregoing mathematical analysis of the actions of forces on cutting tools, it is apparent that new avenues are opened for application of coolants to carbide tools. This is presently being investigated and results will be outlined in a future article.

References

1. Kronenberg, M.—"Metal Cutting Friction Coefficient Needs Reinterpretation," pp. 49-50, THE TOOL ENGINEER, October 1953.

2. *Tool Engineers Handbook*—First Edition, p. 311, *Fig.* 17-12, American Society of Tool Engineers, 1949

3. Mitchell, J. H.—*Proceedings London Mathematical Society*, Vol. 34, 1902

Chatterless Boring Bars

THE NORMAL maximum length-to-diameter ratio of 4:1 will give safe operation and a minimum of chatter for steel boring bars supported at one end. Larger ratios can be used if the bar has a carbide stiffening core. Definite length-diameter ratios can be determined only for specific core and bar diameters.

Also, according to the Carboloy Dept. of General Electric Co., Detroit, Mich., solid carbide boring bars are being used successfully where length-to-diameter ratios exceed that for steel bars. The table shows length-to-diameter ratios for carbide bars.

Workpiece Material	Ratio Ranges
Steel	6:1
Cast Iron	6:1 to 7.5:1
Aluminum	8:1 to 10:1
Brass	8:1 to 9:1

Normal operating ranges of both steel and carbide boring bars can be safely extended if built-in vibration dampers are used. These dampers consist of a slug of heavy metal alloy (Hevimet) "floating" within the boring bar as close to the free end as possible.

Fig. 1. Rods are made with a continuous looping method. The rod at upper left is being broken down in the three-high stand. Rod in the right fore-ground is threading through the rolling stands.

Versatile Hot Rolling Mill Minimizes Downtime

DESIGNED and laid out to meet the exacting requirements of a specialty steel company, this multipurpose hot rolling mill can be used to produce strip, rod and bar. This combination mill, now in full production at the Reading, Pa. plant of the Carpenter Steel Co., has five take-off points for different sizes of a wide variety of grades and analyses of stainless, tool and special alloy steels.

The unusual layout of the mill reduces down time for changing rolls and represents tool engineering of a high caliber. Facilities are arranged so that rolls can be changed in one section while operations continue uninterrupted on the other stands. Since roll stands can be preset, idle time is minimized. Although this operating flexibility is utilized in daily operations, which are carefully scheduled in advance, it is also important in the event of a breakdown. The enforced idleness of one unit, or even several, will not cause the mill to shut down. The new layout concept increases productivity per man about threefold when compared to conventional designs, yet uses standard mill equipment.

Billets are brought in at one end of the 650-foot long mill, are processed through it in straight-line progression and leave as finished products at the other end. These hot-rolled products are scheduled for further cold finishing or annealing in other Carpenter facilities, or for delivery to customers.

Incoming billets are placed in a continuous billet-heating furnace or, if longer soaking times are required, in one of three batch-type furnaces. All furnaces are oil fired and have precise temperature controls. From the furnaces, the billets go to a 20-inch two-high reversing mill for initial breakdown. Flexibility of operation and control over accuracy are possible because this mill has no fixed number of passes. Operator of this stand is in a glass-enclosed pulpit over the reverse pass area and uses both hands and both feet to control the billet travel.

After initial breakdown, billets are delivered to the three-high breakdown mill for further reduction or go directly to the rolling stands. This mill can serve the functions of the reversing mill in an emergency. There are 24 rolling stands arranged so that some can be used as a train for bars, some can be

Fig. 2. Finished coils of rod are delivered to the loading point by this conveyor. Coils, formed on the reels in the foreground, are raised and then pushed onto the conveyor by pushers.

used in tandem for producing strip, and some can be used cross country and looping, *Fig.* 1, for rod.

The mill has a capacity to handle about 6000 tons of ingots per month, with a 25-percent scrap factor from ingot to finished product. The scrap—trimmed ends, test pieces, off-tolerance lengths and cobbles—is carefully segregated for remelting. To insure diversification, the mill is expected to produce equal quantities of stainless, tool and special alloy steels. Titanium can and has been rolled in this mill.

Strip, rods and bars can be produced in a wide range of sizes. Strip can be made from $\frac{1}{2}$ to 10 inches in width in minimum thicknesses of 0.093 inch. Rods are automatically coiled, *Fig.* 2, and vary from $\frac{1}{4}$ to $1\frac{3}{16}$ inch in diameter. Bars are made with diameters ranging from $\frac{3}{8}$ to $1\frac{1}{2}$ inches. After bars are cut to length, they are allowed to cool on a notched bed, *Fig.* 3, which helps to develop uniform grain structure. Strip and rod coils are also individually cooled. The facilities can also be used to cog 14-inch square ingots into billets or rectangular slabs for rerolling.

Reduction of scrap, as well as savings in time, results from the ability to preset roll stands. If the production schedule calls for making $\frac{1}{2}$-inch stainless rod, stainless strip and then $\frac{1}{2}$-inch tool rod, it might be expected that no changes would be required on the rod stands. However, since some materials squeeze more than others, the settings to produce $\frac{1}{2}$-inch stainless rod within tolerances for size and roundness would not make $\frac{1}{2}$-inch tool rod. The latter might have wings, might not be $\frac{1}{2}$ inch in diameter or might be anything but round. Therefore, while the stainless strip order is being run off, the rod stands are adjusted for the change.

Tolerances Held Accurately

Close tolerances are obtained on rods and bars because the material is processed in continuous steps from the furnaces to the coiling devices. In-process temperature loss is held to a minimum so that end-to-end tolerances can be held. Individual motor drives for each stand and individual end thrust adjusting devices on the mill stands aid in high production rates with close dimensional and roundness tolerances. Tolerance on strip width is about plus $\frac{1}{16}$ inch. Rods have out-of-round tolerances between 0.003 and 0.004 inch.

A high-pressure water spray descaling system produces smooth, clean hot-rolled surfaces and minimizes scale pitting. All parts of the mill that come in contact with the rolled product are made of comparatively soft materials such as cast iron. This minimizes abrasion and improves product finish. Inspectors, using a small laboratory adjacent to the rolling space, continually check surface finish and product tolerances.

Because it is 100-percent electrified, the mill can be easily and accurately controlled. Pushbutton electrical controls regulate rolling operations throughout the mill. The controls are located on pulpits, *Fig.* 1, so the operators can see what is going on. The pushbuttons operate relays in the electrical equipment rooms. All rooms containing motors and controls are air conditioned to provide filtered air at a temperature to insure optimum performance. Electrical equipment rooms are located in bays on both sides of the rolling space.

Communications for routine operations and during emergencies are handled by a combined telephone-loudspeaker system that ties together all control points and the superintendent's office, which overlooks the rolling area. The system can be used as a telephone circuit for pinpoint conversations between any two points, or can cover all parts of the mill as a loudspeaker circuit. The single, broadcast word "stop" can rapidly close down all rolling operations. Maintenance men working in different areas communicate with walkie-talkies.

Lubrication of the mill machinery and equipment is by centralized oil and grease systems. Nine thousand gallons of oil are constantly and automatically circulated from heated storage tanks through three major and two sub systems, and back to the tanks. Each line in the 15 grease systems has an automatic regulator that controls the amount of grease going to each point. Ten of these systems feed points in the mill and are combined as a one-shot system. The other five systems are individually operated to lubricate parts on the overhead crane, which runs the full length and covers the full width of the rolling space. The 15 grease systems serve 1,168 points requiring lubrication.

This combined hot rolling mill can reduce the delivery time on specialty products which represent many orders with different specifications, frequently in lots as small as 1,000 pounds. This increased flexibility has been achieved with an increase in productivity and product quality.

Fig. 3. The notched bar cooling bed is the end of the bar line. Rod coils come out on the center line and strip is coiled from the conveyor at the left. The strip line runs straight back to the reversing mill and continuous furnace.

Precision Lathe Cuts Threads on Faces

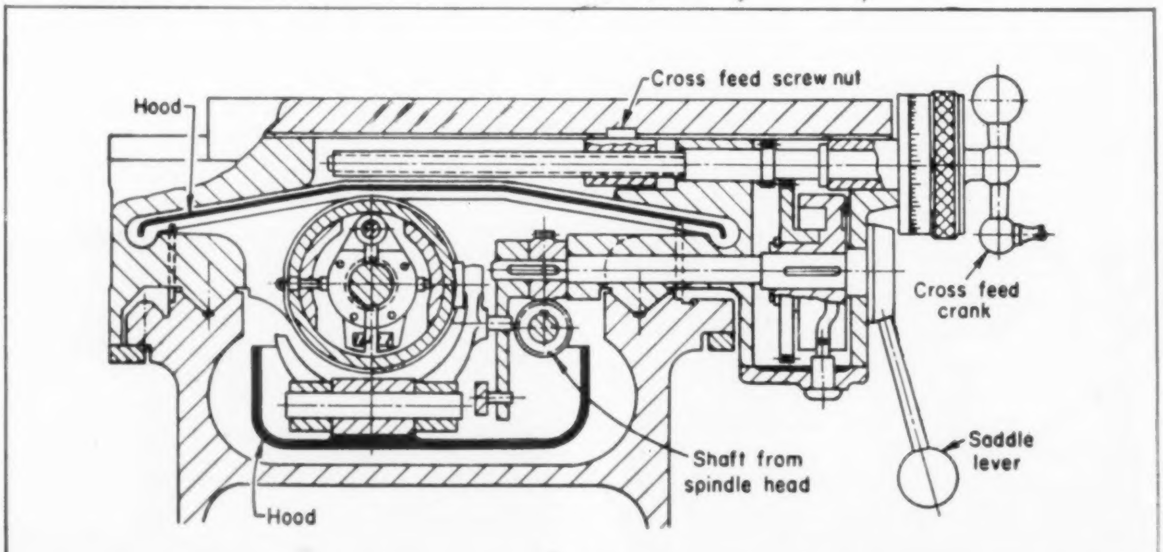
By Paul Grodzinski
London, England

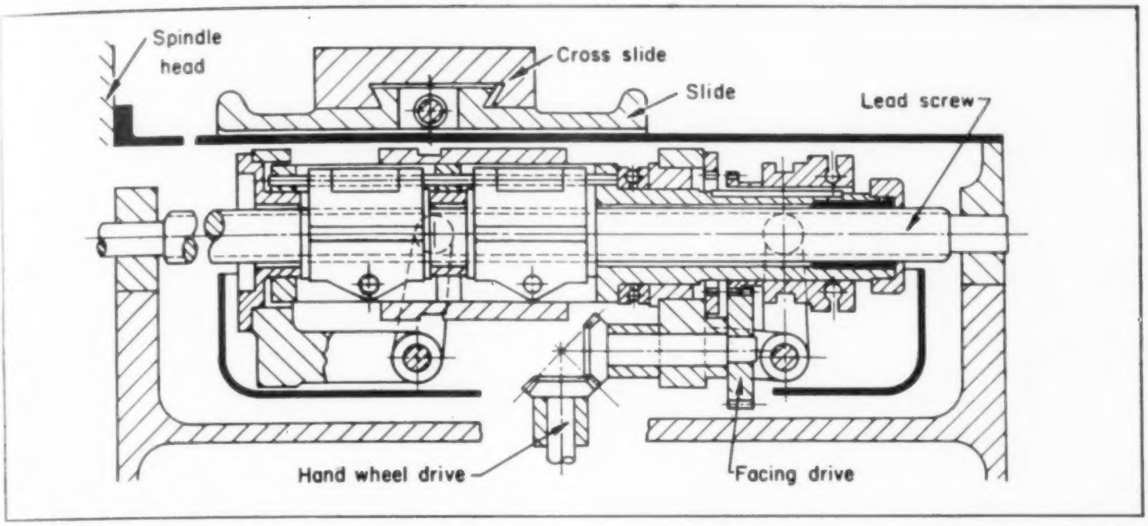
TWO PRISMATIC WAYS support the longitudinal slide of this diamond lathe. High surface finish is possible because the drive for the saddle operates between the supporting ways and weight is uniformly distributed. The main leadscrew and the saddle drive elements operate in an oil bath, and the ways are continuously lubricated. Since force is applied to the saddle at its center, motion is smooth. The average surface finish, when working with diamonds, is less than 1 micron; with carbides, surface finish average height is 1 micron.

Through unusual design of the controls for a lathe, facing feed can be mechanical and threads can be cut on faces. The machine is built by Fritz Werner, Fertigung GmbH, Geisenheim Rheingau, Germany.

The nut for the cross feed leadscrew consists of two sections and is further split through the center. It has two threads with which two clamping devices can mesh. One clamping device controls longitudinal saddle movement during cutting of standard threads, and the other is for feeding and hand operations. Depending on which clamping device is actuated, the nut is locked to the body of the saddle or the leadscrew.

For the longitudinal movement of the saddle, the split nut is mechanically locked to the saddle. For longitudinal movement by hand, with the spindle stopped, the nut is released from the saddle and is driven by the handwheel through gears. When the split nut is clamped to the leadscrew, power is transmitted through reduction gears to drive the cross slide. This results in a mechanical facing feed and permits cutting threads on faces.





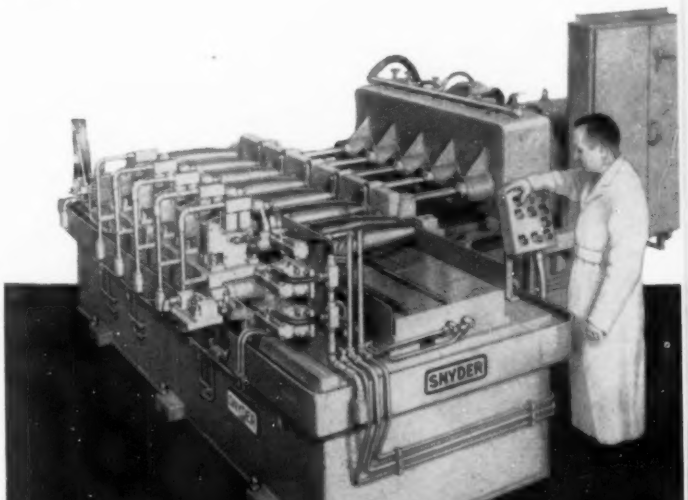
A SINGLE LEVER controls all movements of the saddle for thread cutting and feeding (longitudinal and transverse). Two protecting hoods extend over the full length and width of the bed, one on top and one below, to protect the leadscrews, ways and saddle drive mechanism. The hoods are attached to the side of the spindle head and the end of the bed, passing through a slot in the saddle. Gaps between the hoods and external edges of the ways are closed by vertical sheet metal hoods attached to the saddle.

Hollow Spindles Pass Coolant for Long Unsupported Cut

During the processing of 155 mm shell bodies, several machining operations must be accomplished inside the 6-inch diameter of the shell. Drilling, counterboring, countersinking and reaming are accomplished with a machine in which the tools reach unsupported 20 inches into the shell. The machine is built by Snyder Tool & Engineering Co., Detroit, Mich.

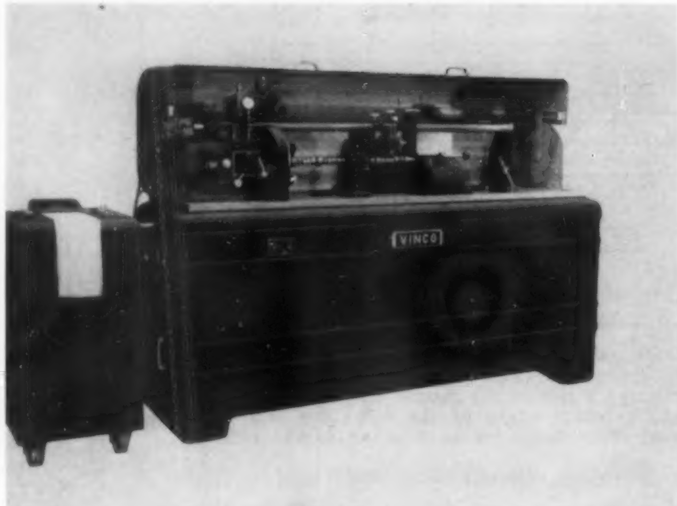
The machine has an automatic cycle with five working stations. The operator rolls a shell down a slight incline against a stop in the loading station. The shell axis forms a right angle with the line of index. The index mechanism lifts the shell and carries it to the second station where it is automatically located and power-clamped by pressure against the shell ends. The supporting yokes then fold down to clear the shell when the index mechanism returns.

All indexing, locating and clamping motions are accomplished with hydraulic cylinders. Coolant is supplied from a separately mounted tank and pump and, after the machining operations have been completed, coolant and cuttings are removed by hydraulically tipping the shell to empty it through the throat in the nose.



HOLLOW SPINDLES and central tube openings in the tools permit coolant to be fed to the cutting edges while tools operate at a point 20 inches inside 6-inch shell bodies. Processing of the burster tube recess, which is located in the shell base, necessitates this method of cooling because the only practical access to the burster tube is through the threaded throat in the nose of the shell. Tools are high-speed steel operating at 70 fpm with infeed of 4 ipm and a stroke of 25 inches.

Recording Camshaft Comparator Features Reproducibility of Results

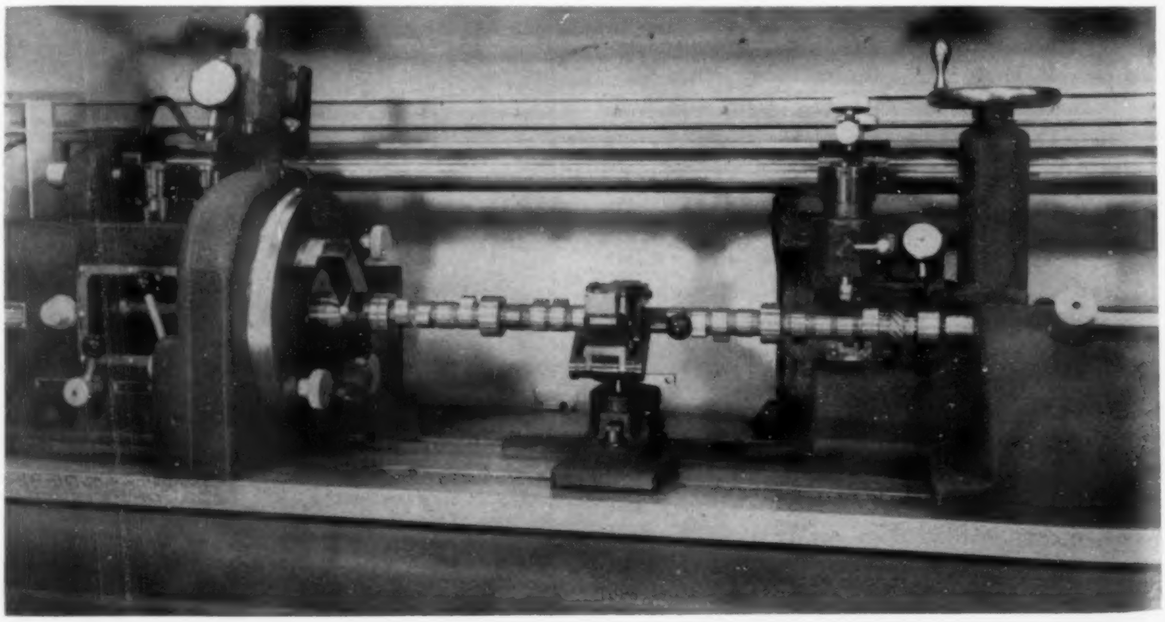


RECORDING CAMSHAFT COMPARATOR is a complete unit with a protective hood that swings down when the equipment is not in use. The separate recording unit is mounted on casters so it can be used in the most convenient location. Capacity of the comparator is 44 inches between centers, journals to 2⅜ inches in diameter, and cams up to 1⅝-inch diameter base circles with rises of ⅝ inch. Cam contour variances are shown on a 0.0001-inch dial indicator and simultaneously recorded on a linear chart. Cam-to-cam or cam-to-drive key timing can be measured to within one minute of angular position.

Although this instrument is tooled for an individual camshaft, a wide range of sizes can be accommodated because of its flexibility. Camshafts that are similar in all respects, except cam contour, require only a minor tooling changeover. Masters and qualifying masters for each change are produced by Vinco Corp., Detroit, Mich., designers and builders of the Model 78-466 recording camshaft comparator. Because of multiple checks on the performance and setup of the instrument, reproducibility of results is assured. The instrument should be operated in a clean work space.

The motor-driven, high-precision spindle has a carbide work center as does the tailstock. The headstock has two followers and accommodates up to

CAMSHAFT IN POSITION between comparator centers is set up for complete check on accuracy. A trained operator can make a full inspection in 20 to 30 minutes. One to four master cams are mounted on the headstock spindle, visible through window at left. Each cam is independently keyed. Master cams are hardened, ground and lapped to within 0.0001 inch of the mean part print coordinates. The rugged precision tailstock has a spring loaded, manually retracted carbide center. It is moveable along a precision keyway that assures true alignment with the headstock. A qualifying master cam, duplicating the master cam to within twenty-five millionths of an (0.000025) inch, is mounted on an arbor. When mounted between centers, this qualifying unit quickly indicates the proper function and accuracy of the comparator.

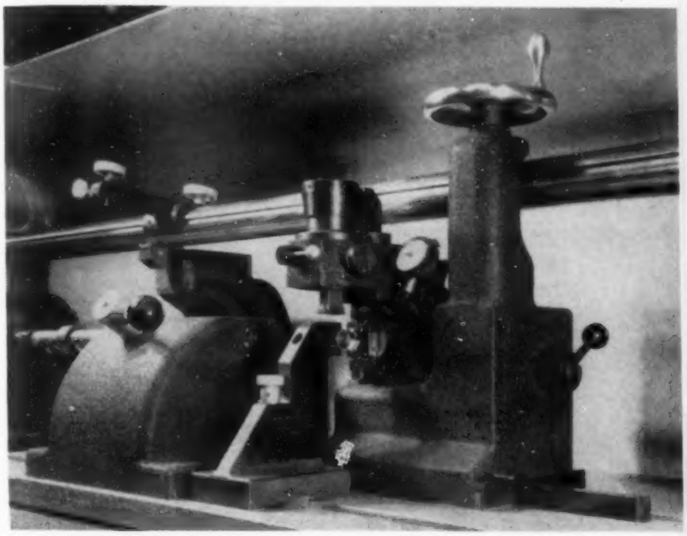


four master cams. Each of the carbide tappet followers has two operating positions. A follower rides on top of the selected master cam and operates a rocker lay shaft connected to a similar mechanism over the selected work cam. The differential of the tappet lifts between the master and work cams is shown on an indicator and simultaneously recorded on the chart.

The headstock spindle carries a disk graduated in half degrees that, by means of two verniers, indicates the accuracy of cam-to-cam and cam-to-drive key timing. A master cam is positioned by means of an index plate and pawl so that each individual work cam can be zeroed. When motor driven, the spindle makes one revolution in 30 seconds and stops automatically.

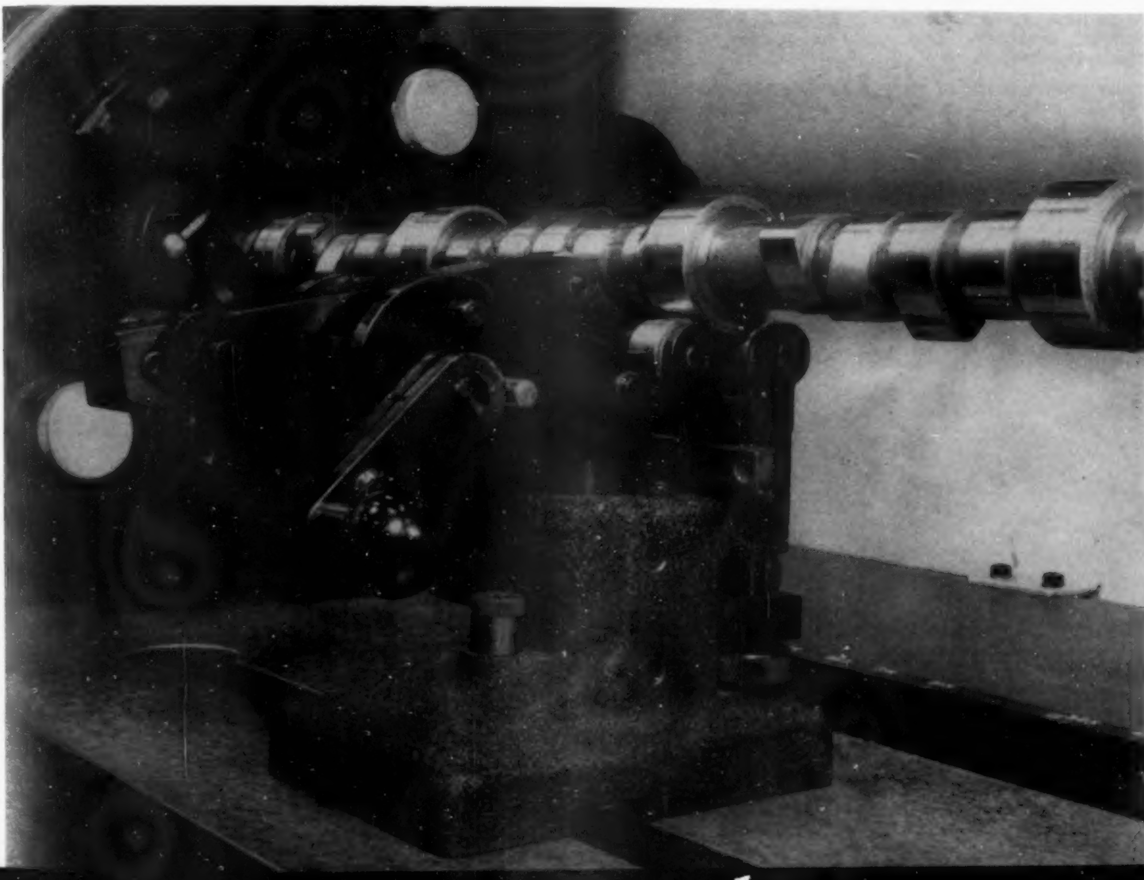
The bed plate is of master surface plate quality. It is a hand-scraped plate of fine grain alloy cast iron, heavily ribbed for stability, and has a three-point leveling support.

The cam follower unit contacts the work cam and simulates tappet action. The follower is in a vertical position over the cam and is mounted in a preloaded ball bearing sleeve protected by a dirt shield.

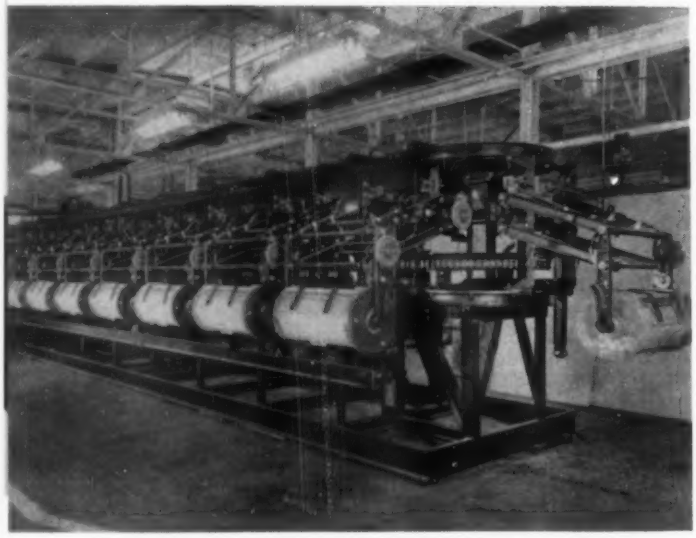


THE ZERO MASTER is a cylindrical member positioned accurately in relation to the horizontal zero position of the master cam or cams in the headstock. The zero master unit mounts in the same keyway as and to the right of the tailstock. The V-type zero locator, shown opposite the zero master, is positioned from the zero master and serves to set the true zero position of each work cam. After the correct registry between the work and master cams has been established, the contour of the work cam can be compared to that of the master cam. Contour differences are shown on the indicator and the chart. Cam-to-keyway angular errors can be read at the work driver vernier. Errors in cam-to-cam angular spacing and the intake-to-exhaust pattern are observed on the intake and exhaust verniers on the graduated headstock disk.

UPPER ROLLER of three-roller work steady rest manually retracts for ease of loading. The two lower rollers nest the journal and the top roller, acting under pressure, constrains the camshaft into alignment simulating engine mounting. The lower rollers can be adjusted to fit other journal sizes by inserting set blocks.



Automatic Plating Barrel Conveyor Includes Operating Flexibility



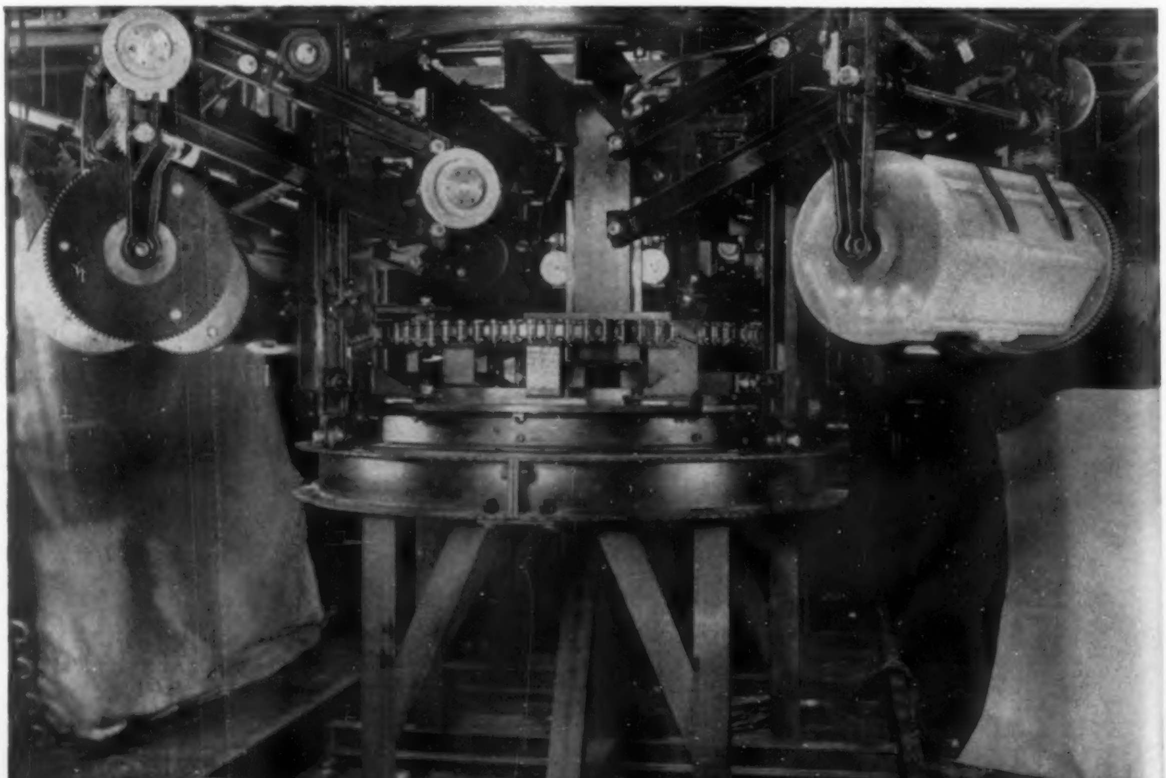
Laid out for a normal zinc plating cycle, this fully automatic plating barrel conveyor is designed and built for any standard plating process. The conveyor is of the return type and is manufactured by The Udylite Corp., Detroit, Mich.

Timer controlled speed and power operated skip transfers make this machine flexible. Also, the tumbling speed of individual cylinders can be independently regulated. All cylinders are capable of individual lowering or raising.

Plated work is dried after it is unloaded from the machine. This is conducive to efficiency because the work, not the barrel, is dried. Drying is done in a conventional drum drier or centrifuge, or the machine can be equipped with electrically controlled, heated air chutes.

CYLINDERS ROTATE when raising and lowering which reduces drag-out losses and solution contamination in this automatic plating system. The machine is designed so that none of the operating mechanism is over the tanks except V-belt drives which will not rust. Separate chains are used for the conveyor and for elevating so that elevating stresses are not imposed on the conveyor chain. The machine is electrically and mechanically operated. A power operated hopper, with weighing scale, is used for loading the machine. The operator pushes a button to raise the hopper to loading position.

END VIEW of the horizontal barrel machine shows the transfer position. The machine has one loading and 10 work stations on one side, one work station at the end, eleven work stations on the other side and the unloading station at the other end. Cylinders are made of Tempron or acrylic resin, 30 inches long and 14 inches ID. Cylinders revolve in a trough of anodes in the plating tank. Because the anode containers conform to the barrel size, and because they are on both sides of the cylinders, solution resistance is a minimum.



Process planners in pressworking advantageously use an organized method of analysis in their job.

Process Planning

for presswork tooling

By W. J. Potthoff*

Chief Process Engineer
Emerson Electric Mfg. Co.
St. Louis, Mo.

and

E. A. Reed**

Asst. Chairman, Industrial Engineering Dept.
General Motors Institute
Flint, Mich.

This article, abstracted from the third chapter in the forthcoming *ASTE Die Design Handbook*, exemplifies the authoritative treatment given the many phases of sheet metal pressworking. This new work is intended to fill the need of tool engineers for a complete reference book in this field, as a companion to the *Tool Engineers Handbook*. It is based on production proved designs and the accumulated experience of many outstanding authorities in the field.

At the outset of process planning, the decision must be reached whether the contemplated product, as-designed or with permissible redesign, will be stamped entirely, in part, or not at all. The decision calls for coordination of design, materials, methods, tooling, manufacturing and any other functions that may be affected.

Design Factors: Shapes suitable for sheet-metal pressworking are limited to those that may be produced by cutting, bending, forming, drawing or compressing. Maximum sizes are limited chiefly by the types and sizes of available presses. There are few limitations upon minimum size; sections as thin as 0.003 in. are possible, with parts so small that 10,000 may be held in one hand. Plus or minus 0.002-in. tolerances are common and closer tolerances are possible on small and thin parts. Parts formed from sheet metal are lowest in weight, in

---

*Senior member ASTE St. Louis chapter.
**Senior member ASTE Flint chapter.

pounds per square inch of surface. Surface smoothness is excellent since surface condition is usually unaffected by the forming operation. A wide choice of materials in sheet form is available, including any which has acceptable physical properties for forming. Design changes are usually costly if required after the original tooling has been completed.

Cost Factors: Tooling time, compared with other production methods, is adverse for pressworked

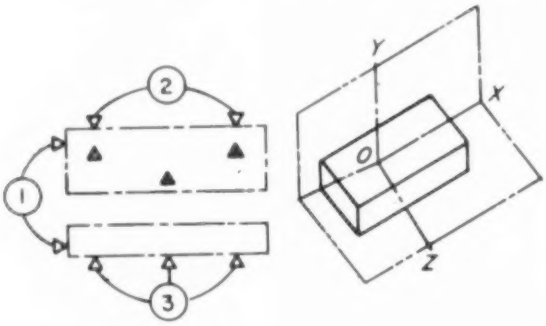
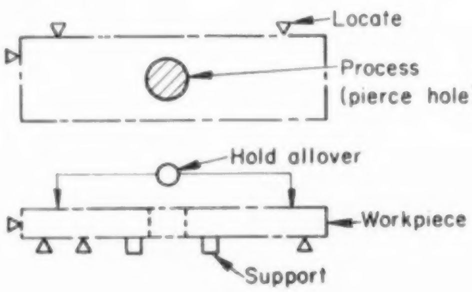


Fig. 1. Postive location of the workpiece is provided by the 3-2-1 geometric system illustrated. Three points determine the horizontal plane of the part (XOZ), two points determine the vertical plane (YOX), and one point completes its location in space.

Fig. 2. Process symbols show locating points, areas where the die must support the workpiece, specification to be held and the particular operation to be performed.



parts except for temporary or low-production tooling. Die design, tryout and development may take months. On the other hand, production time is favorably low, since the rate of output is high; as many as 3000 pieces per hour have been produced.

Stamping materials costs should be considered low, ranging from three to four cents per pound for steel, up to 25 cents per pound for aluminum and higher for some other less used materials. A favorable cost factor is the minimum scrap loss achieved through careful selection of stock and skilled strip layout.

Tool and die costs are high, usually higher than for comparable parts that are to be diecast. Costs are most favorable where large production is in view. Direct labor costs depend upon the part size and shape; under normal conditions they are characteristically low. Presses, except for the small manual punch presses, are typically more costly than standard machining equipment such as lathes and grinders and require a higher machine-hour rate. Finishing costs are low. Often no other finishing is required than painting or plating.

Planning Basic Procedure

The pressed metal process planner generally has three major areas of responsibility: (1) Planning the sequence of operations and specifying the tooling, metalworking equipment and gaging necessary to produce good parts economically at a specified production rate; (2) coordinating allied processes such as heat treatment, metal finishing and plating; and (3) integrating required material handling and operator movement paths. The second and third responsibilities are executed by specialists and so are considered no further.

The following steps constitute a logical procedure for planning a pressed metal manufacturing process:

Analysis of the Part Print: It may be desirable to have enlarged layouts, additional views, experimental samples, models and limit layouts for analysis. It will be helpful to chart assigned responsibility for carrying out the specifications. The product designed must establish explicit detailed specifications for size, shape, material type and condition, and allied processes. The process planner must be left in no doubt as to all the definite and implied specifications and their interrelationships.

All manufacturing operations and allied processes should be listed. A typical tabulation would be:

1. Pierce hole, 0.501 in. + 0.002/-0.000
2. Flange, 90 deg ± 2 deg
3. Buff external surfaces
4. Blank.

No attempt should be made at this point to list the operations in proper sequence or to combine the operations but only to make a preliminary survey of basic operational requirements. Each listed item should be checked off on the part print drawing.

Manufacturing practicality should be determined. The possible die operations that could produce the part with the specified surface relationships should be considered. A hole close to a flange, a small radius, a draw requiring annealing, a blank that cannot be economically nested—these and other conditions can frequently be improved by the product designer without affecting functional requirements. Upon completion of part print analysis, recommendations should be written to the product designer. All accepted recommendations call for necessary engineering changes in the part print.

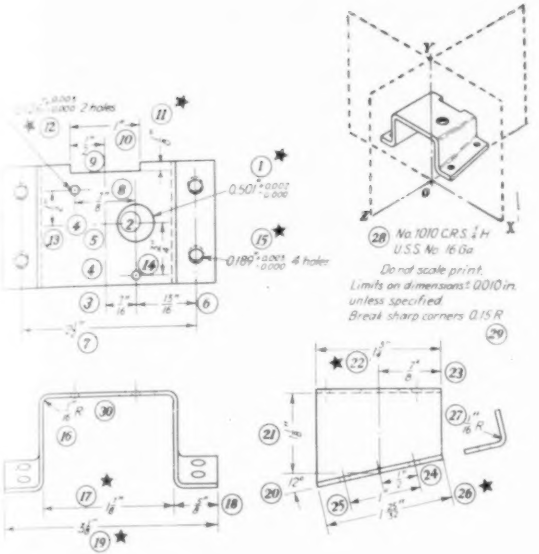


Fig. 3. (above) Cross-shaft bracket. Circled numbers refer to separate operations analyzed in *Fig. 4.*

Fig. 4. (right) Tabular analysis of cross-arm bracket specifications.

TABULAR ANALYSIS

PART NAME *Cross shaft bracket* DATE *Feb. 1, 1954*

PART NUMBER *P-460 529* PLANNER *E. A. Reed*

No	SPECIFICATIONS	BETWEEN SURFACES – DEPEND ON			REMARKS	OPERATIONAL REQUIREMENTS
		MATERIAL	DIE	PROCESSING		
1	0.501" +0.002 -0.000	✓	✓		Squareness implied 90°	★
2	℄ Part to ℄ 0.501" hole			✓		
3	7/16" to 0.501" ℄ 0.125" holes			✓	Possible limit stack with spec. No. 6	
4	℄ to ℄		✓		Implied coincident	
5	℄ ⊥ ℄		✓		Implied 90°	
6	13/16"	✓	✓	✓		
7	2 1/2"	✓	✓	✓		
8	7/8"		✓	✓		
9	1/2"		✓	✓		
10	1"	✓	✓		Squareness implied 90°	★
11	1/8"	✓	✓	✓		
12	0.125" +0.003 -0.000 (2) holes	✓	✓			★
13	1/2" to 0.125" hole		✓	✓		
14	3/4" to 0.125" hole		✓	✓		
15	0.189" +0.003 -0.001 (4) holes	✓	✓		Squareness implied 90°	★
16	1/16" Radius (2)	✓	✓		Implied 90° bend	
17	1 7/8"	✓	✓			★
18	5/8"	✓	✓		Possible limit stack with spec. No. 17	
19	3 1/8"	✓	✓		Implied symmetrical	
20	12"		✓	✓	No tolerance on ∠	
21	1 1/8"		✓	✓	No tolerance on flatness or parallelism	
22	1 3/8"	✓	✓	✓		★
23	℄ to 7/8"			✓		
24	℄ to 1/2"			✓		
25	1"		✓	✓		
26	1 25/32"	✓	✓	✓		
27	1/16" Radius (2)	✓	✓		Implied 90° bend	★
28	1010 C.R.S. 1/4 H U.S.S. No. 16 Ga.	✓			Tolerance on thickness	
29	Break sharp corners 0.015" R	✓		✓	Question need	Not needed

ferent parts which have several common shape or size specifications.

Determining Most Economic Processing: For the same part to be stamped, there are usually several alternative production methods. The method selected should be the one which, all factors considered, will result in the lowest over-all cost of the part. The cost will include material, tooling, direct and indirect labor, and overhead burden.

Determination of the most economical processing can be accomplished by comparing two or more feasible processes for producing the given part. The comparison of unit costs for each process, considering equal production quantities, will give a break-even point which is a guide to selecting the most economical tooling. Productive labor costs and burden rates are estimated from past performance and by the use of standard time data.

A graphical presentation of the break-even point is useful where the spread between processes is small. Where the spread is small, but increased production is a future possibility, it may be preferable to use the higher-cost process.

Unless new pressworking equipment can be amortized over a rather short period or have future value as standard equipment, it may prove more economical to use existing available equipment even though production costs would be higher.

Likewise, simple dies may be favored over high-production dies which seem indicated by the anticipated requirements because special skills are required to design, construct and maintain high-production dies. Also, the simpler single-operation dies may permit interchangeability of tooling for different parts which have several common shape or size specifications.

Planning the Sequence of Operations: Operations planning, done solely on the basis of past experience, can prove costly if seemingly minor details are overlooked. Any dimensional specifications which have comparatively close tolerances or limitations because of allied processes are known as "critical" specifications. Study of the comparative effects of specifications upon surface relationships, with the aid of a limit layout, will reveal the critical specifications from a manufacturing standpoint.

Most critical specifications pertain to measurement of surface relations within specified tolerances. Critical areas are those areas or surfaces from which the measurements for all specifications can be taken to determine the geometry of the part. Limit layouts serve also to determine the critical areas. In ideal planning, critical areas should be established first, provided they are "qualified" as surfaces of registry for subsequent operations and allied processes.

A manufacturing operation is designated as "critical" when it is required in order to establish a critical area or an equivalent area, from which subsequent operations or allied processes can be performed. The required degree of control over stock variations such as width, thickness, camber,

mechanical properties and metal flow characteristics are basic factors in determining the critical manufacturing operation. The ideal critical manufacturing operation would establish the critical areas in a single operation from the sheet, strip or coiled stock.

Accomplishing critical manufacturing operations is the major responsibility of the die designer, working to the process plan. The process planner, however, must know the basic types of dies, their general applications and the control of disturbances due to metal-flow characteristics which may affect part accuracy. He must also consider the die designer's problems of deflection, wear control, dirt, and workpiece mutilation.

Secondary manufacturing operations are intermediate between the critical manufacturing operations and the finished part. Limitations in these operations are those imposed by the workpiece specification and by the amount of metal flow or movement.

Additional secondary operations may sometimes be necessary to coordinate with an allied process, or to re-establish a critical area for subsequent operations.

Allied processes are ordinarily determined during part print analysis. Exceptions may occur through emergency or necessity. Thus, an annealing operation may become necessary after secondary manufacturing operations have been determined. In some cases, the process planner may avoid annealing by recommending a change in material specifications. Elimination of annealing, plating, cleaning and other allied processes, where possible, will appreciably reduce total manufacturing costs.

While allied processes are usually the function of specialists, the pressed metal process planner must deliver a workpiece in suitable condition for the allied processes. The specialist should advise the processor of the effect the allied processes will have on the workpiece.

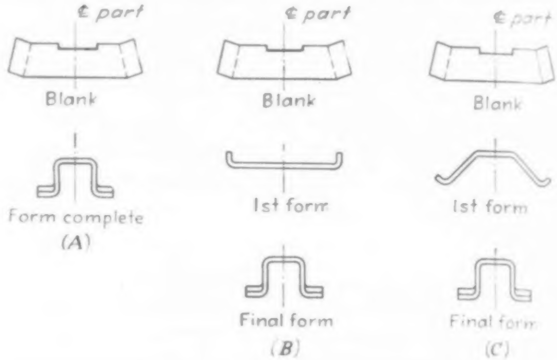
Specifying Gaging and Equipment: As-received material should be gaged for width, thickness and camber for specified tolerances. In-process gaging should be planned for use during manufacture and follows the same procedure as used to select critical areas or areas from which measurements can be taken to defend the geometry of the workpiece. The workpiece should be prevented from continuing through the sequence of operations if it is defective due to a previous operation.

A press should be specified according to the actuation requirements of a die, the type of pressworking operation to be performed, properties of the workpiece material, and the required production accuracy.

Preparing Routing of Process: The operational machine routings vary in form throughout industry but must meet two common essential requirements: description of the operation must be accurate and complete, and the nomenclature should follow accepted practice. A pictorial sketch of the part, shown on the operational machine routing sheet, aids considerably.

System for Locating the Workpiece

To locate the workpiece it is necessary to establish qualified surfaces of registry. The surface of



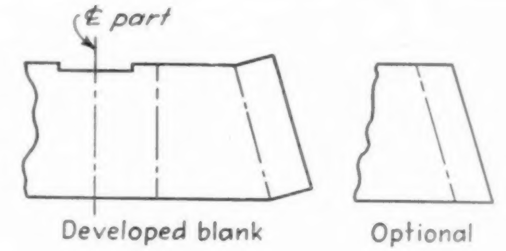


Fig. 5. (above) Alternative methods for forming the cross-arm bracket.

Fig. 6 (below) Developed blank for the cross-arm bracket.

the device used by the die designer to establish the locating point specified by the process planner is known as a "seat of registry." The corresponding area on the workpiece is known as a "surface of registry." Qualified areas are those areas which fulfill the requirements of arithmetical, mechanical and geometrical tests in order to serve as surfaces of registry.

1. *Arithmetical Test:* The selected surface of registry must not cause a stacking of limits. If no surfaces of registry can be selected, they must be qualified, i.e., must be produced to a tolerance closer than that required and specified by the product engineer.

2. *Mechanical Test:* The size, shape and finish of the selected surfaces of registry must permit a seat of registry so each will withstand the operating forces exerted and also the necessary holding forces.

3. *Geometrical Test:* This test pertains to the distribution of the surfaces of registry so that the workpiece will be positionally stable. If surfaces of registry are not thus qualified, the process planner must consider suitable redesign with the product engineer.

In this 3-2-1 geometrical locating system, *Fig.* 1, six points are the minimum number of points required to fix a cube or rectangular solid in space. Three points establish a plane, two points define a straight line and one more point completely in space is required to locate an object. A small pyramid symbol is used to designate a locating point. Variations of the system can be used to fix the location of a cylinder, cone, disk or other geometric shapes.

Process planning symbols can be used to avoid lengthy notes on sketches and prints in the preliminary stages of planning. *Fig.* 2 illustrates use of such symbols.

Specific Application of Process Planning

Although sound general principles are always of value, their application to pressed parts demonstrates their practical usefulness. In the following case study the process planning procedure is applied in detail:

This part, *Fig.* 3, has a forecasted production of approximately 100,000 per year. In some plants the process planner might be expected to furnish a preliminary routing so that unit costs might be estimated. Such routing might indicate: (1) blank and pierce; (2) first flange; (3) finish flange; and (4) inspect; together with other normally required information and specifications.

Although such preliminary routing may satisfy estimating needs, it does not always insure quality parts, economically produced. For such goals, it is essential to apply the accepted planning procedure.

Study of Specifications: Each specification, dimensional or noted, must be studied to understand exactly what is specified by the product engineer. One method used by the experienced planner is to check off each specification on the print after it has been interpreted to his satisfaction. For the less experienced planner, a tabular analysis such as in *Fig.* 4 will prove more effective because it is a record of information on all specifications shown or implied on the part print.

This technique in process planning classifies all specifications concerned with surface relationships and reveals whether the relationships depend upon the material, the die, the processing, or some combinations of these factors.

The process planner is primarily concerned with the die and processing columns, but in order to plan an acceptable sequence of operations, the items in the remarks column must be clarified in consultation with the product engineer. The product engineer must also be consulted to ascertain if any proposed changes in materials specifications, for avoiding manufacturing difficulties, will affect the part's functional requirements. In extreme cases, a study of the materials considerations might show the wisdom, or even the necessity of changing to some other process. In short, discussions between the process planner and the product engineers should resolve the difference between what is specified and what is wanted.

Operations Required: Basic operational requirements for the cross-shaft bracket are:

1. Cut 1 notch..........$\frac{1}{8}$ x 1 in.
2. Cut 1 blank..........$3\frac{1}{8}$ x $1\frac{3}{4}$ x $1\frac{25}{32}$ in.
3. Pierce 1 hole..........0.501 in.
4. Pierce 2 holes..........0.125 in.
5. Pierce 4 holes..........0.189 in.
6. Form 2 bends..........$\frac{1}{16}$-in. radius
7. Form 2 bends..........$\frac{1}{16}$-in. radius.

These operational requirements, excluding the first two items, will be examined briefly.

Operation No. 3 (pierce one hole, 0.501 in.): No problems are apparent in producing this hole. Tolerance is close, but not impossible with properly maintained tools. The natural break from piercing will provide adequate surface in the hole to meet functional requirements.

Operation No. 4 (pierce two holes, 0.189 in.): No problems are apparent in producing the holes. The natural break from piercing will provide adequate surface in the hole to meet functional requirements.

Operation No. 5 (pierce four holes, 0.189 in.): No problems are apparent in producing the holes. The product engineer objected to the suggestion of keeping all hole axes in the same plane, which might have simplified tooling and processing.

Operations No. 6 and 7 (form four bends, $\frac{1}{16}$-in. radius): These forming operations are similar in some respects and, combined, would constitute the complete forming of the part. Therefore, they evidently merit being analyzed together.

The forming operations consist of working a flat blank into a shape which will meet part print specifications, plus any decisions reached between the process planner and the product engineer. Controllability of the blank, the metal flow and movement, and quality of finish are factors coming under practicality for manufacturing and economics of tooling.

Alternative Methods of Forming: Three possible methods of forming the flat blank to obtain the final shape of the cross-arm bracket are shown

in Fig. 5. In the single-operation method shown at *A*, the developed blank would be placed in the die having a suitable locating system. In a single stroke, the metal would be worked over almost the entire surface in forming the blank to shape. In such a method, the surface on the die radius would be subject to excessive wear and, under production conditions, the part might have a mutilated surface. Also, it would be difficult to control springback and the part symmetry because of variables of the material, even though the pad would hold the blank securely against the punch face. The 12-degree flange on the part, *Fig.* 3, would cause a localized flow of material, upon initial closing of the die, which would also distort the part.

In the two-die method the developed blank would be flanged on the ends in one die, then the sides would be formed by a single-pad flanging die. Methods *A* and *B* both provide fair control of the part but, in both methods, springback control is difficult when flanges are parallel.

In the method shown at *C*, using the same blank, a single solid-type die could both form the end flanges and establish the break lines for the sides. In the final forming stage, the sides are flanged in a single-pad die. Blank control would be good and springback in the end flanges could be compensated for by over-bending. Since both of the break lines are established in the same operation, with minimum metal flow and movement in the die, a better dimensional quality should be secured in the part.

It therefore appears to the process planner that the method shown at *Fig.* 5 *C* would be the most satisfactory, permitting combined blank and pierce operations if hole location tolerances were sufficiently large.

Preparing the Blank: In studying a part print, the process planner will assume in practically every case an initial blanking operation will be needed to prepare a flat piece of material for the subsequent operations. The blank for the cross-shaft bracket is shown in *Fig.* 6, after the blank has been developed, the process planner must consider utilization of the material, grain direction as related to blank nesting and any other pertinent factors.

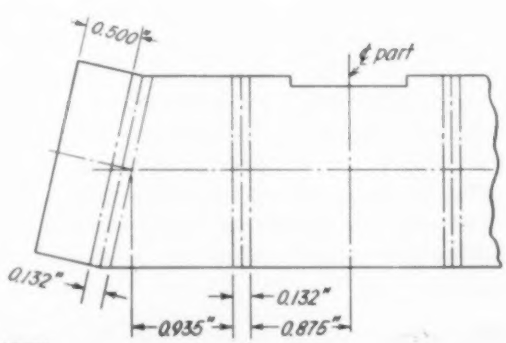
The shape of the ends of the developed blank, *Fig.* 6, requires a skeleton of material between the banks. If, however, the product engineer can be convinced that the optional blank, *Fig.* 6, will not affect the part's functional or structural requirements, then both material and die costs can be lowered.

Material grain direction will be no problem in this plan, because the specified quarter-hard SAE 1010 cold-rolled steel will form satisfactorily either across or parallel to the grain direction. The ⅛x1-inch notch is, in effect, a portion of the outline of the blank. There being no metal flow or movement in the notch area, the decision should be to include the notch in the blanking operation.

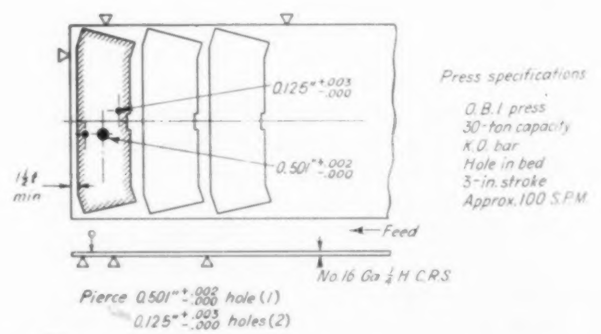
Establishing Surfaces of Registry: The major decisions on the basic operations for the cross-arm bracket having been made, the next step is to determine the critical specifications and establish the critical areas which can be used as surfaces of registry. Since close tolerance is an indication of critical specifications, the process planner should consider the 0.501-inch hole and the two 0.125-inch holes. The 0.189-inch holes might also be considered on the basis of close tolerance, except for the facts that there is metal flow between the planes of the two groups of holes and that the planes of the 0.501-inch hole were established as common to all flanging operations in the forming of the part.

Hence, the surfaces of the 0.501-inch and the 0.125-inch holes become the critical areas from which the surface of registry may be selected. Since a minimum of six points are required to locate the workpiece, the process planner will use the inside surface of top side for the three points, the 0.501-

Fig. 7. Process sketch sheet for guidance in designing dies for producing cross-arm bracket.



A Basic dimensions for blank development



B Operation no. 10—blank and pierce

inch hole for the two points, and the 0.125-inch hole for the one point in his 3-2-1 hole locating system.

This system should then be checked to determine whether the selected surfaces of registry are qualified arithmetically, mechanically, and geometrically.

Arithmetically, the selected areas are qualified because of their close tolerances. The holes have a maximum 0.004-inch tolerance, as compared with location dimensions having plus or minus 0.010-inch or 0.020-inch tolerance.

Mechanically, the 0.501-inch hole (item 1) in *Fig.* 4 qualifies satisfactorily since a ½-inch diam pin is structurally adequate for the two seats of registry. The true sheared surface of the hole will extend only about 30 percent through the thickness of the stock, because of the metal action in piercing the hole. This will not disqualify the surface, since only one point in each plane is needed.

The 0.125-inch hole (item 12) qualifies for the other surface of registry, except that so small a hole does not permit a structurally adequate locating pin for a seat of registry. Therefore, it is necessary to select some other surface of registry such as the edge of the blank. This edge is qualified because it is to be produced in the same die that produces the holes. Since a workpiece of this type would be nested, the equivalent of a nest is indicated in the operation diagrams, *Fig.* 7, *C*, *D*, and *E*, by a "locate" symbol.

Geometrically, the 0.501-inch hole would be qualified to provide the necessary seats of registry to locate the workpiece because the inside metal surface of the hole provides the required three points.

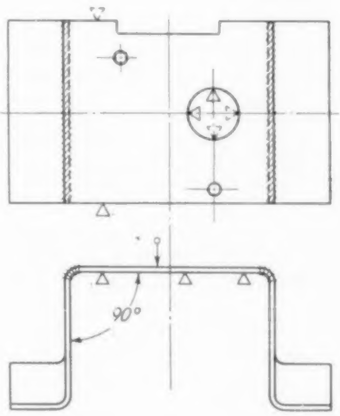
The 0.125-inch hole is geometrically qualified in relation to the 0.501-inch hole, because it provides an adequate distance between surfaces of registry for locating purposes. It was, however, previously disqualified mechanically because of small size.

Use of Sketch Sheets: Critical manufacturing operations are those required to obtain critical areas for secondary operations. The holes could be pierced first and then used to locate for a blanking operation. In this instance it is obviously practical to blank and pierce in the same operation.

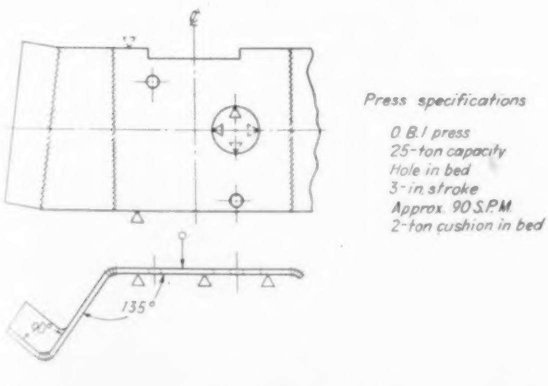
Since the same locating system can be used both for the forming operations and for piercing the 0.189-inch holes, this information should be passed along to the die designer in the form of process sketch sheets, *Fig.* 7, which supplement the usual machine and tool routing sheet.

Process sketch sheets show the workpiece for each operation. Only those views are shown which are necessary to specify the surfaces of registry and any dimensions needed other than those given on the part print. On each sheet showing an operation, the required press specifications are given.

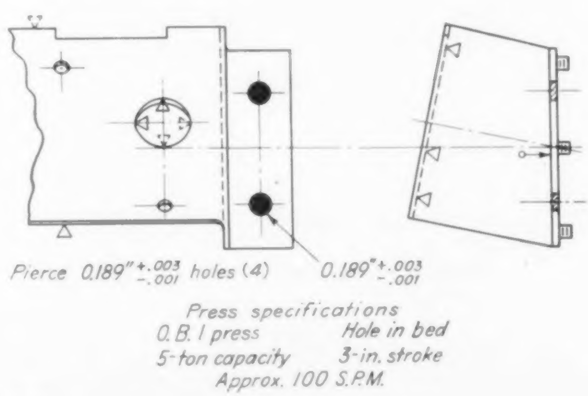
The machine and tool routing sheet will indicate the gages which must either be designed or selected from commercial standard sizes. Allied processes, such as heat treating or tumbling, were considered and determined as unnecessary in producing the cross-arm bracket.



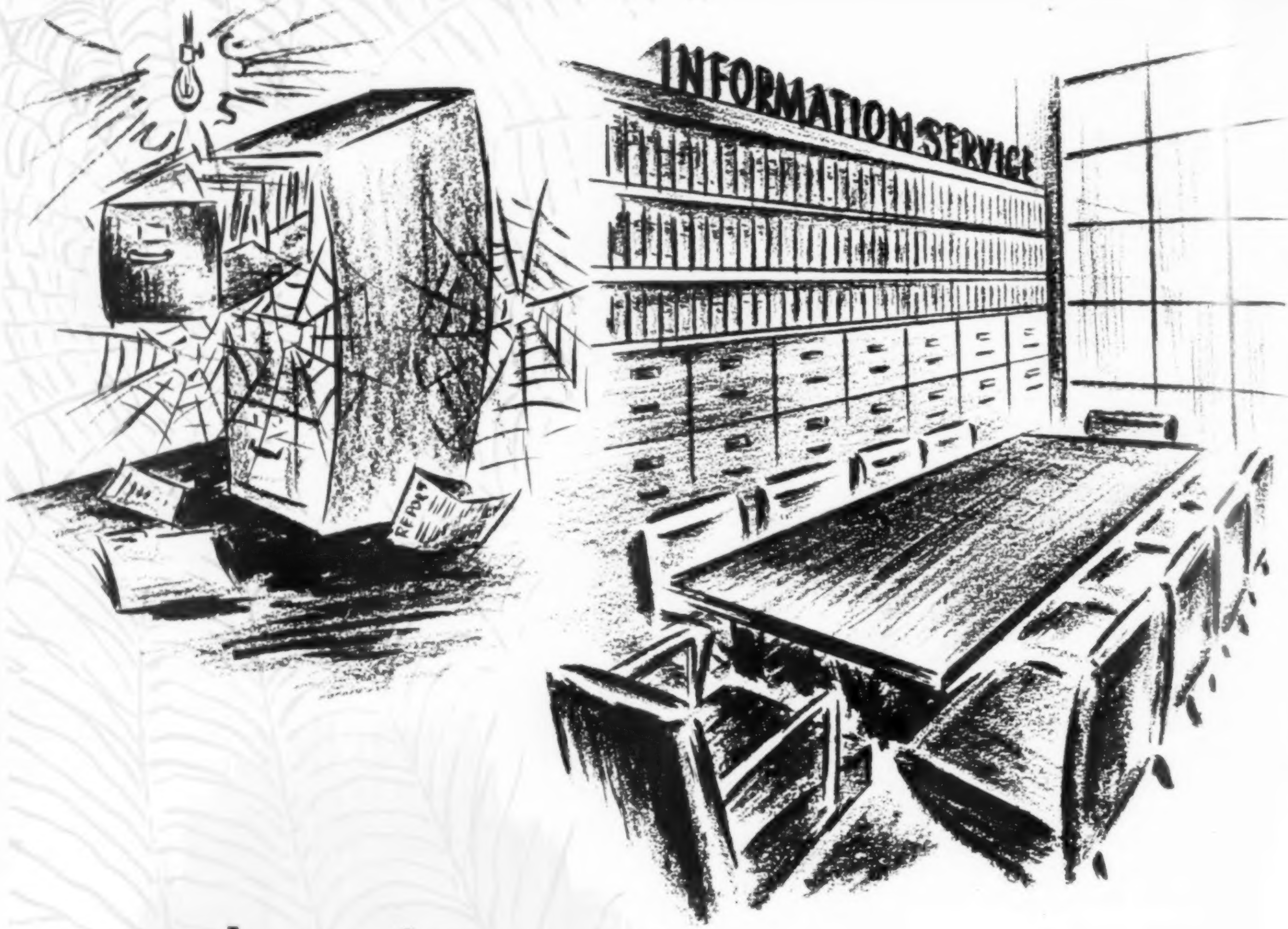
D Operation no. 30—final form



C Operation no. 20—first form
End flg. 90 deg. Side flg. 135 deg



E Operation no. 40—pierce



dynamic organization of technical information

By Maurice Holland

Research Management Consultant
New York, N. Y.

RAPIDLY INCREASING complexity and precision in machining operations mean that today's tool engineers must be familiar with many types of standard and specialized production equipment and tools. Even a relatively simple tool design problem or machine specification may require scores of references to technical information. Technical society papers, manuals, handbooks, catalogs, advertisements, articles, engineering bulletins and fact sheets are all important sources of technical data.

A tremendous amount of engineering time is wasted and overhead expense is incurred searching for technical information that is poorly selected and improperly organized. Engineering management thus has a basic responsibility for maximizing the efficiency of its technical staff by seeing that adequate information is both immediately available and as easy as possible to use.

Failure to recognize this responsibility is particularly serious now because the volume of technical information in all phases of engineering is growing more rapidly than ever. Even in limited areas, it is

virtually impossible to organize all new information as fast as it becomes available.

What the Engineer Needs

In order to insure maximum use of any technical information service, the engineer must have full confidence in what the service offers. The tool engineer assumes that the information is:

1. Adequate—all he needs should be readily available.
2. Properly classified—he should be able to find it rapidly and easily.
3. Thoroughly cross referenced—he should be referred to information for which he is not specifically looking but might find helpful.
4. Up-to-date—obsolete information should be removed and replaced.

Although the engineer does not think in terms of adequacy, classification, cross referencing or obsolescence, he is quite conscious of deficiencies in the information he finds. His confidence in the information service is weakened if he finds outdated material or only partial answers. The service ceases to be a tool if a poorly designed classification leads the engineer to frantic and unproductive page flipping.

Pertinent Information

The information that is required in any engineering department depends on the scope of the company's tooling requirements. Major factors affecting the type and quantity of pertinent information include: (1) variety of engineering responsibilities, (2) degree of original machine tool development (in contrast to special adaptations or slight design changes) and (3) extent to which development responsibility is delegated.

A company with limited tooling requirements would select only specialized information in a narrow phase of engineering. A multiproduct manufacturer producing new models each year would have many times more technical information.

Informational needs of a top-notch tool engineer with long experience in a specialized field are much different from those of a young engineer who is building his store of knowledge with each new tooling project. If development responsibility for individual projects is widely delegated, the personal experience of a few old-timers will be inadequate to supply the informational needs of a large staff of young engineers. If the tooling group is a tightly knit team of experienced engineers, a smaller pool of more advanced information is sufficient.

A tool engineer usually needs both specific and general information. Specific information relates directly to a current job, while general information covers related factors which may not be directly useful to the specific job but which can help clarify the area of attention. It is through general information that the engineer has the greatest opportunity for creative development.

The tool engineer can rarely set down all the requirements and properties of a machine or tooling setup at one time. Specifications are built up as the development progresses. The amount of information required to serve as a foundation for selecting and applying all components intelligently is tremendous.

This article will describe one method of organizing published information. Unpublished information can be added to such a file, or be built up separately, in the form of memoranda. Such memoranda should each cover one specific product or material and give pertinent data on: forms in which available, characteristics, performance, uses to which it can be put, and purchasing.

Dynamic Organization

With few exceptions, most present methods of organizing information are static—a bad habit on both a large scale (public libraries) and on a small scale (desk files). It is common practice to decide on a permanent classification and then make every bit of the growing volume of information fit the classification. Wrong decisions are made every day in placing information where it does not quite belong.

Technical information should be organized and indexed dynamically. The indexing system must be revised continuously to match the growth and development of the information. When a group of related

A research advisor and consultant to industrial corporations, governments and research foundations, Maurice Holland has worked closely with Sweet's Catalog Service in research, planning and development. Because a research organization depends on complete, up-to-date technical and scientific information, the organization of information as a creative tool has been one of Mr. Holland's primary interests. He was for 20 years Director of the Division of Engineering Research of the National Research Council, and is well-known as an author and teacher on research management.

Table 1—Classification of Machine Tool Catalogs

1—drilling, boring
boring machines
(horizontal, jig, precision, vertical)
drilling machines
(automatic, deep hole, multiple spin, radial, sensitive bench, sensitive floor and pedestal, unit head and way type, upright)
reaming machines
tapping machines

2—milling
(bed type, bench type, die sinking, horizontal, knee type, planer type, profiling and duplicating type, ram type, thread milling, universal, vertical)

3—turning
(automatic chucking, automatic screw, bench, boring, combination boring and turning, engine, floor—light duty, threading, toolroom, turret, rifling, lathes)

4—planing
broaching machines
(horizontal—internal and surface, vertical—internal and surface)
gear shaping machines
gear shaving machines
key seaters
planers
(double housing, openside, plate)
shapers
slotters

5—grinding, honing
(bench, floor, snag, buffing, cylindrical—internal, cylindrical—external, disk, lapping, polishing, surface—rotary, surface—reciprocating, thread, tool and cutter)

6—shearing, pressing
bending machines
(bending brakes, bending rolls, rotary head, ram type)
forging machines
hammers
(steam or air, mechanical)
presses—hydraulic and pneumatic
(horizontal, vertical, combination etc.)
presses—mechanical
(bulldozers, double and triple acting, horizontal, inclinable, vertical, vertical—gap or C frame, vertical—adjustable bed and horning)
punches
shears
(bars and angle, combination, plate, rotary)
swages

7—sawing
circular, reciprocating, band

8—heat treating, welding
forges
furnaces
induction heating
ovens
positioners
welding and cutting equip., etc.

9—special machines
automation equipment, etc.

10—other equipment
attachments
accessories
cutting tools
gages

ideas are first organized there may be only a half dozen classifications. Several years later there may be hundreds of classifications, but no more or less than is necessary to permit the engineer to find what he wants in the least time. The best filing system is inevitably the best finding system.

How to Organize Information

Dynamic organization of information begins with the development of a flexible system for classification and indexing. A classifiction is an operational or functional listing of sections in which information is logically adjacent in both subject matter and location. Specific information is surrounded by other information that might be helpful. An index is a tool, usually an alphabetical listing, for finding specific information within the classified sections.

A typical classification is shown in Table 1 for organizing company catalogs on machine tools. As with all dynamic information pools, the technical knowledge covered by the classification in this table has grown and will continue to grow each year. Future growth will require expansion of the classification. To cover technical information for the design phases of a tool engineer's function, another entirely different classification may be necessary.

After any classification is developed needed changes will become apparent. If one classification section or subsection covers too much territory, either in bulk or by subject, it should be split. When the user can no longer pinpoint a subject because it is not evident in the classification and is buried in a subsection, the information service is starting to revert to a pile of dusty books and papers.

If new material does not fit into an existing classification, it is an indication that reclassification is necessary. The more a point is stretched to fit a bit of information into the classification, the better is the chance the information will never be found again. Maintaining an effective classified information service is a continuing process of creating, eliminating, relocating and renaming classifications. Sections and subsections of the classification should be arranged and named in terms of the engineers who will use the service.

An Index Is Needed

The frequent user of an information pool may be able to locate desired data through familiarity with the classification. However, one or more indexes would prove desirable. Although it is possible to index almost any body of information in countless ways, the three indexes most used by industry cover product, manufacturer and trade name.

The listing under "b" in the product index corresponding to the classification in Table 1 is shown in Table 2. The subsections under "boring, drilling and milling machines" in Table 2 are given in Table 3. The indexes in Tables 2 and 3 provide for cross reference in major classification. Thus, the index under "band saws" refers to "cutting machines" and "saws or sawing machines" for related information. Except in the rare instance when a company name or trade name is changed, an index by product, company or trade name is inherently dynamic through growth alone.

Identification of information in a classification should be simple, open-ended and include key symbols that can be applied to information from all sources. Key symbols most common to product information, for example, would relate to the name of the producer. A catalog of the Eternal Machine Tool Co. would be identified by the symbol "2/Et" in the classification used in Sweet's Machine Tool Catalogs,

Table 1. Section 2 covers milling and this catalog would be filed in this section alphabetically according to "Et," the first two letters of the manufacturer's name. There is then no limitation on the amount of information that can be stored alphabetically and a particular piece of new information can be given a symbol easily.

How to Keep Information Current

Only a small fraction of information gathered is really brand-new, involving fields of investigation yet untouched in the information already classified and indexed. Most of the growth is adding to, modifying or replacing what has already been organized. While everyone recognizes that an entirely original bit of information may require a new index listing or classification, little is done with information already covered by an established classification except to mark and file it. Probably the most important single activity of any information service is the correlation of new material with similar information already classified.

If the classified material is useless in view of the new information, it should be thrown out. Certainly, operating characteristics and setup pointers on an obsolete grinding device are unnecessary, and possibly harmful, when full descriptions and performance data on modern precision surface grinders are available. Similarly, an ASTE paper discussing recommended speeds and feeds for planers and shapers would be a more appropriate addition as general information for reference than as specific data on a new tool.

Table 2—"b" Listing in Product Index

balancing	boring machines
band saws	brakes.
bar machines	brazing equipment
benches	broaches
bending machines	broaching machines
blades	brushing machines
blowers	buffing and polishing machines
boring and facing machines	burnishing
boring, drilling and milling machines	burring machines

Table 3—Subsections of Product Index Listed under "Boring, Drilling and Milling Machines"

attachments for	planer type
horizontal	side head
indexing or attachments for	vertical and universal head

Although elimination and replacement of obsolete information is primarily a matter of judgment, the tool engineering group can usually record a set of pointers to aid in evaluating material. The only strict rule that should apply in all cases is that no information should be discarded unless it is also replaced. Nothing is obsolete unless there is something newer. Following are several common forms of incoming information and typical questions that will indicate whether it should supplement or replace existing classified material:

1. Textbooks—are they more recent editions?
2. Catalogs—if issued by the same company, are they same or newer material?
3. Ads and mailing pieces—does the newly announced product replace older models?
4. Articles and papers—is the discussion more thorough, more appropriate, include more recent data?

Administrative Factors

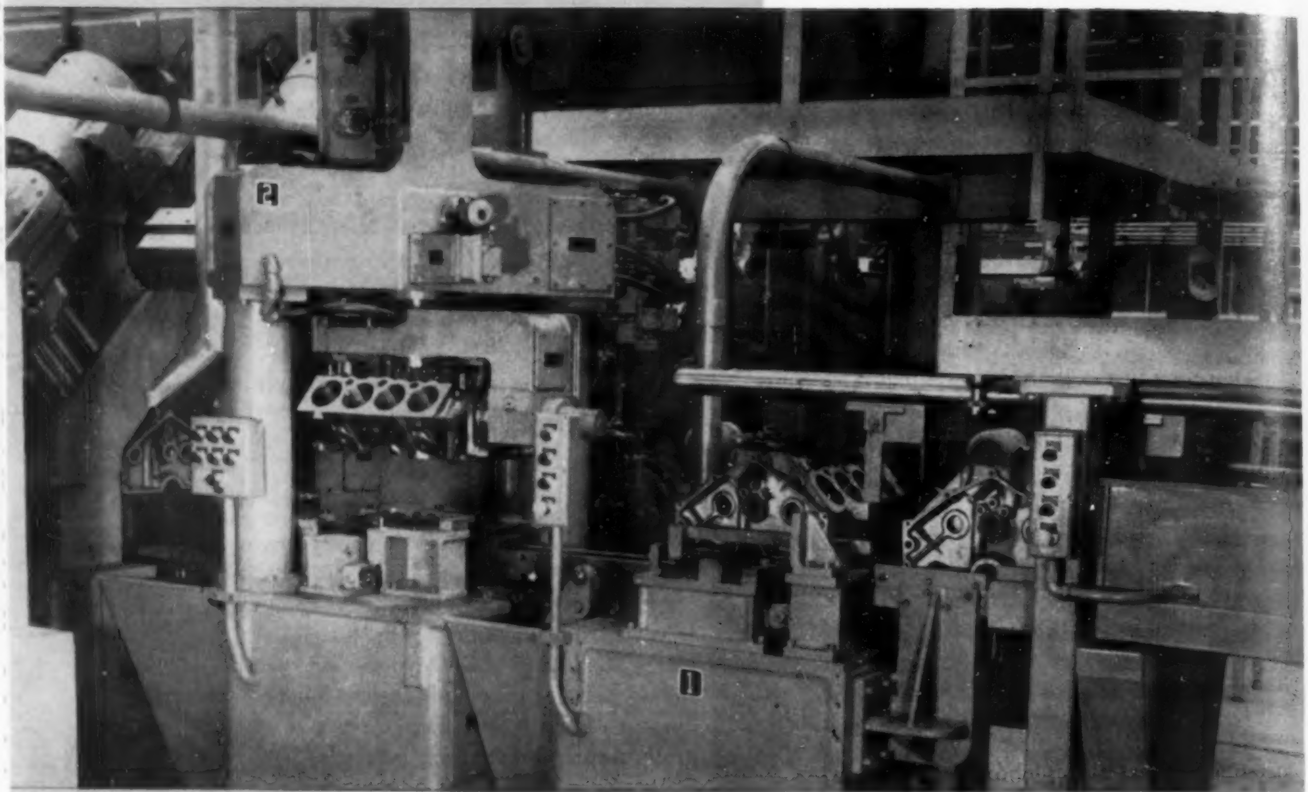
Evaluation and possible revision of the classification, and elimination of obsolete material can be accomplished at the same time and should be done periodically. Such an accounting made annually is usually sufficient. Although the actual upkeep of the information is simply a filing job, one engineer should be made personally responsible for the development of the information service. Committee or group responsibility rarely succeeds.

There are many forms in which information can be organized—file folders, shelves of books, bound catalog collections, microfilm, ringed notebooks and permanent binders are typical. The particular forms selected are determined by the scope of the information, number of engineers using the information, variety of forms in which the information is obtained, standard company procedures, individual preference and many other factors.

Supply and maintenance of technical information should be the responsibility of the entire engineering staff. In terms of gains possible, little time is required by individual engineers to evaluate and classify incoming information that is made available to him. Classified material should then be routed to the information pool via engineers who are known to be working on a similar problem.

Copies of the most recent master classification and indexes should be distributed to all engineering personnel. Recording of the information in alphabetical indexes can be easily done by clerical personnel, with the assistance of the engineer in charge, if necessary.

Engineering management should consider an information service as a budgetary item. Overhead costs include floor space, stationery and salaries of the service personnel. The secretarial and filing staff will vary from a fraction of an individual to a highly organized independent team. Since the value of the service far exceeds its actual cost, the amount of the budget allowance is not nearly so important as the fact that the technical information service is officially recognized as indispensable by management.

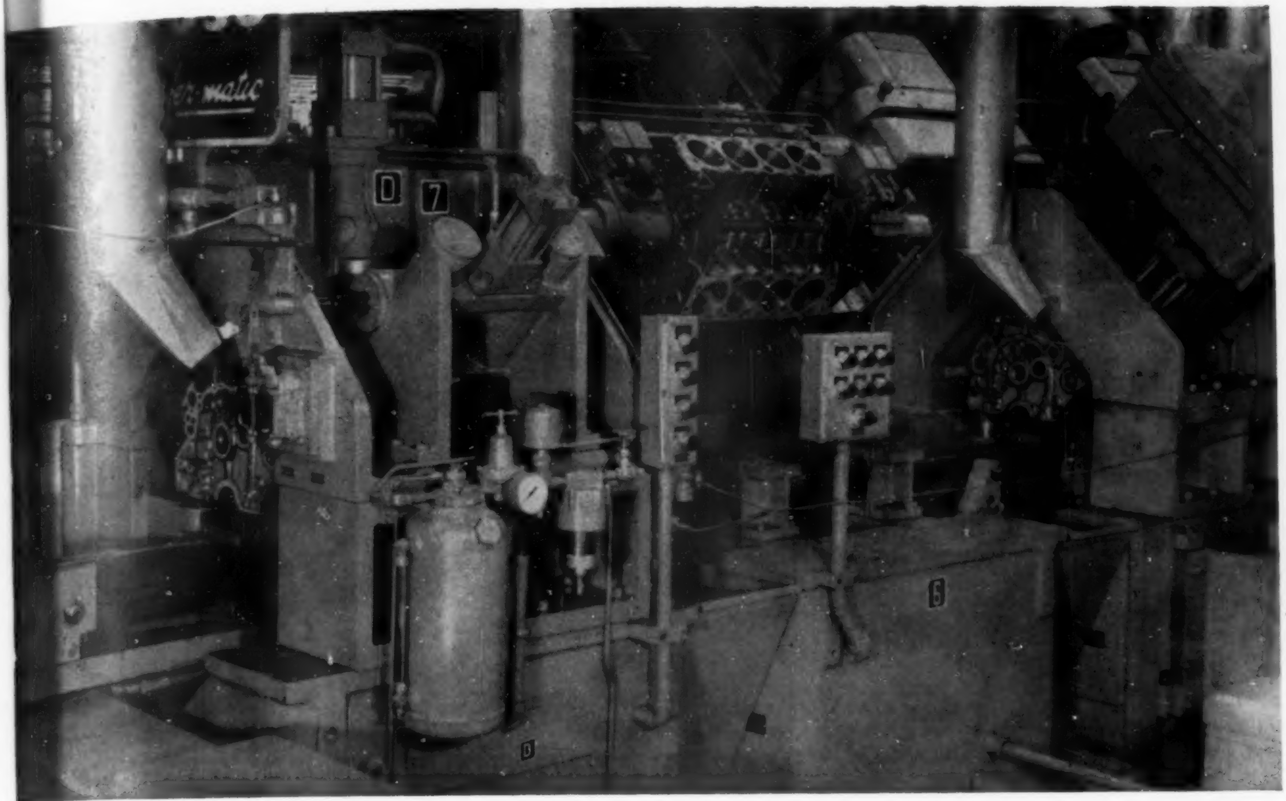


SECTIONIZED AUTOMATION, a basic advance in transfer-type operations, is used to deliver a V-8 engine block from one station to another. This machine, developed by The Cross Co., performs 555 drilling, chamfering, tapping, camshaft boring and miscellaneous milling operations on 100 cylinder blocks in process at one time. The 350-ft machine is divided in five sections and is automatically controlled and programmed so that if one section is shut down for tool changes or repairs, workpieces are banked in front of the down section. Production continues uninterrupted. Time lost by one section is regained by overtime operation.

TOOLS at work

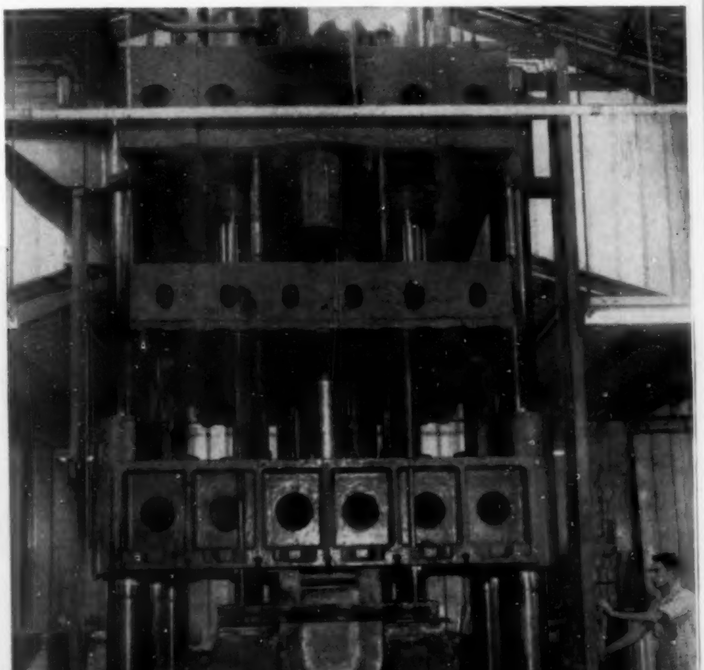
SLITTING OPERATION on aluminum casting at Ryan Industries, Inc., Detroit, uses wax coolant. The 18-in. cut in the 0.075-in. material previously was difficult due to loading of the saw teeth and tool breakage after 20 pieces. Production has increased a third and 500 pieces are run without trouble now.

—Photo courtesy S. C. Johnson and Son, Inc.



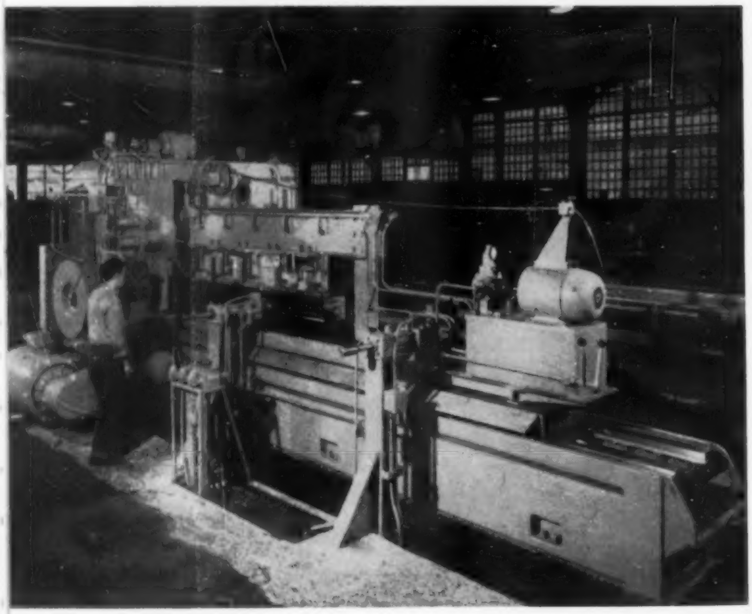
AUTOMATIC INSPECTION of cylinder bank-face holes is performed by probing in station D-7 (left) after holes have been drilled (right) and chips dumped in 360-deg rotation, station 6. If the part fails the test, the section automatically shuts down.

—Photo courtesy Beech Aircraft Corp.

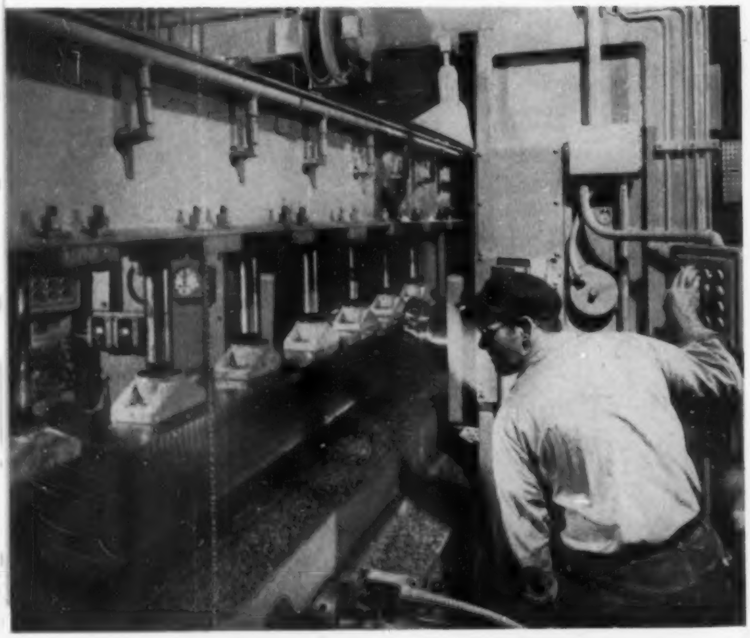


PLASTIC DRAW DIE, with steel draw rings and die rails, forms tapered aircraft part to tolerance of plus or minus 0.015 in. With the blank in place, the punch is first run down to within a few inches of the bottom. At this point the metal is locked into place, held by the edges, and pressure is applied for final shaping. The punch is roughly 14 ft long and tapers from 2 to 4 ft in depth. Over-all weight of the set is 18,000 lb. Of steel, weight would have totalled about 60,000 lb.

TOOLS at work



DUPLEX MILLING MACHINE finishes both edges of wide cold-rolled flats simultaneously at Jones & Laughlin Steel Corp., eliminating a bottleneck in production. Table speed during rough cuts on medium carbon steel is 32 ipm and for finishing cuts about 17½ ipm. The flats are destined for many tooling uses and so require high dimensional accuracy, flatness and straightness.



SPECIAL HYDRAULIC clamping fixture holds the flats in place during milling. The fixture was designed by J & L tool engineers who also designed the loading and unloading tables and the hydraulic work-positioning devices which align the flats on the clamping fixture prior to machining the edges. Workpieces shown are a stack of thirty-two ¼-inch bars 12 feet long.

HOW TO SHARPEN HOBS

for Optimum Gear Production

By Stuart J. Johnson*

Chief Engineer
Small Tool Div.
Barber-Colman Co.
Rockford, Ill.

ONE OF THE MOST essential factors in producing high-quality gears is accurate sharpening of the hob. It is the only element of hob accuracy left to the user to maintain, *Fig.* 1. Regardless of the original class and quality of the hob, unless it is resharpened to established tolerances, it will not produce accurate gears.

Action of the hob generates the form on the part with each individual tooth removing a small chip in the cutting zone. The teeth cut into the work, one behind the other, each in a slightly different position, *Fig.* 2. The cutting action is continuous, the single-thread hob making one complete revolution for each tooth on the gear, *Fig.* 3. This places each hob tooth in the correct position at the right time to remove its small chip to form the gear tooth profile. Any error in the hob which places any of the hob teeth out of their correct position will reproduce an error on the profile of the gear. Spacing of the gear teeth is practically never affected by hob sharpening errors except when multithread hobs are used in cutting a number of teeth that is evenly divisible by the number of threads.

Classes of Hobs

Tolerances to which gear hobs are manufactured have been standardized and the standards published by the Metal Cutting Tool Institute. In these standards hobs are divided into different classes, depending on their accuracy. While tolerances have been published for runout, bore, profile, lead and sharpening, only the ones for sharpening, TABLE 1, are of concern here.

In addition to the gear hob classes: Class A, precision ground; Class B, commercial ground; Class C, accurate unground; and Class D, commercial unground; the Barber-Colman Co. has developed Class AA ultraprecision ground. This class is manufactured to tolerances closer than those for Class A hobs, assuring more consistently accurate gears. When any hob is manufactured and delivered to a customer, however, it is guaranteed to be within the limits for its class. This assures that the hob is of a certain accuracy and will maintain that accuracy throughout usable lifetime if it is sharpened within the limits for its class and size.

Proper Sharpening Procedure: To insure maximum gear production, particular attention should be paid measurement, recording and control of hob wear. A number of effective systems have been devised to increase life of hobs. The basic essential, common to all systems, is a record card which follows the hob throughout its life. This card should contain date the hob was received, manufacturer, engineering data pertinent to the hob, number of gears cut per sharpening, number of shifts, number of gears cut per shift, amount

Fig. 1. Typical high-speed steel hob being sharpened on grinder built specifically for this purpose.

* Senior member ASTE Rockford chapter.

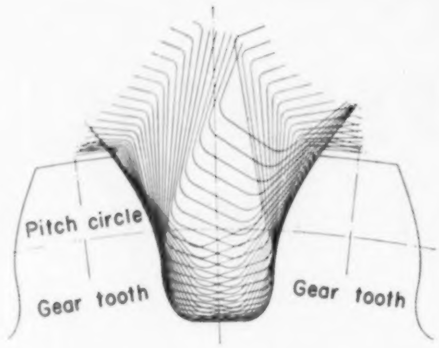


Fig. 2. Generating action of a hob cutting profiles of gear teeth.

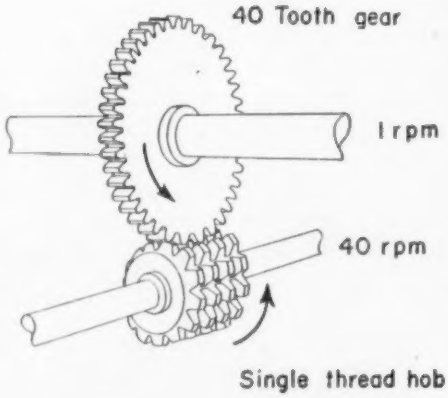


Fig. 3. Hob and work rotate in a geared relationship.

of stock removed at each sharpening and date of sharpening. With such a card system, factors involved in hob wear can be studied.

One of the most important features of a system for control of hob wear is a method to determine amount of stock which must be removed to restore sharpness. This must be kept to a practical minimum for best tool life. The most successful devices for measuring hob wear use microscopes with crossed hairlines and a micrometer controlled platen. The exact wear, to thousandths of an inch, can be determined. Some manufacturers have designed and made their own gages for measuring wear. Although probably less accurate than microscopic gages, they serve the same purpose.

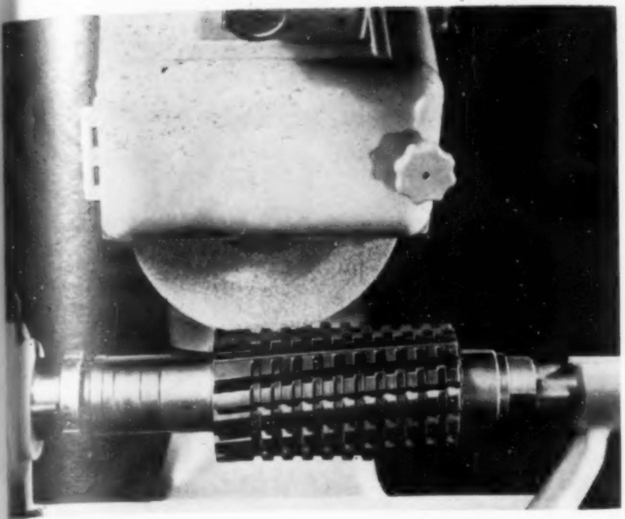
Hob Material Removed: The best way to increase hob life is to remove only enough material when sharpening it to restore proper cutting edges. Often, one section will be dulled more than the rest of the hob due to hard spots in the gear blanks, or cutting too many gears in one position. It is wasteful both of grinding time and hob life to sharpen the hob until all teeth are sharp. Instead it is advisable to sharpen the hob only until all teeth are sharp except those that were excessively dull. The teeth in the dull section should be marked so that the machine operator will avoid using them. This recommendation applies only where hobs are shifted manually.

For best results, hobs should be sharpened as soon as finish and accuracy begin to be affected by dullness. Excessive dullness not only decreases hob

Hob Sharpening Tolerances
(in tenths of a thousandth of an inch)

		Diametral Pitch										
Characteristic	Class	1.000 Thru 1.999	2.000 Thru 2.999	3.000 Thru 3.999	4.000 Thru 4.999	5.000 Thru 5.999	6.000 Thru 8.999	9.000 Thru 12.999	13.000 Thru 19.999	20.000 Thru 29.999	30.000 Thru 50.999	51.000 and finer
	AA	—	—	20	15	10	8	8	6	6	6	6
Spacing between	A	40	30	25	20	15	10	10	10	10	10	10
Adjacent Flutes	B	50	45	40	30	20	15	15	10	10	10	—
	C	50	45	40	30	20	15	15	10	10	10	10
	D	60	60	50	50	30	25	25	20	—	—	—
	AA	—	—	40	35	25	15	15	15	15	15	15
Spacing between	A	80	60	50	40	30	30	30	25	25	20	20
Non-Adjacent Flutes	B	100	90	80	60	50	50	50	40	35	30	—
	C	100	90	80	60	50	50	50	40	35	30	30
	D	120	120	100	100	80	80	70	60	—	—	—
	AA	—	—	10	8	6	5	5	3	3	3	3
Cutting Faces	A	30	15	10	8	6	5	5	3	3	3	3
Radial to	B	50	25	15	10	8	7	7	5	5	5	—
Cutting Depth	C	50	25	15	10	8	7	7	5	5	5	5
	D	100	75	50	40	30	20	20	15	—	—	—

		Face width, inches				
		0 to 1	1 to 2	2 to 4	4 to 7	7 and up
	AA	8	10	15	20	20
	A	10	15	25	30	50
Accuracy of Flutes	B	10	15	25	30	50
Straight and Helical	C	10	15	25	30	50
	D	15	23	38	45	75



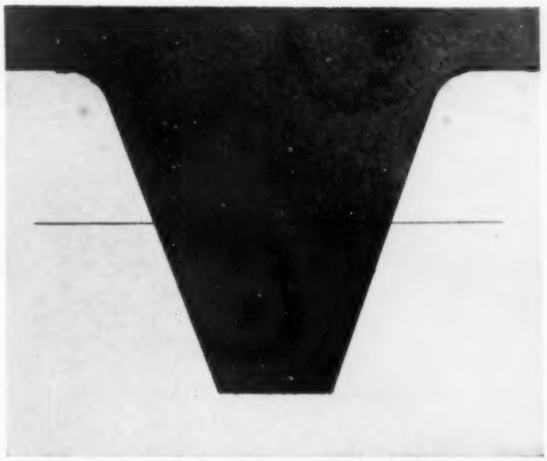


Fig. 4. (top left) In making a setup for hob sharpening, the arbor must fit snugly to avoid runout.

Fig. 5. (top right) Profile of a tooth on a correctly sharpened hob.

life, it also increases the possibility of further damage to the hob teeth.

Grinding Wheel Feed: The feed is generally given in terms of decimals of an inch per revolution of the work. Because of the many factors involved, it is difficult to give specific values that would be correct in all cases. Material of the hob being sharpened is an important factor. High-speed steels used for most hobs vary in composition. The harder the material to grind, the less the feed should be. Carbide-tipped hobs are quite hard and cannot stand much pressure on the tooth face during grinding. Hobs with deep flutes present more area for the wheel to contact than a shallow-fluted hob of the same diameter and require a lower speed. A higher helix angle will also restrict the feed of the hob as the hob contacts more face area in the same length of table travel. The type of grinding (wet or dry) will also affect the amount of feed. Wet grinding allows a greater feed, as the coolant dissipates the high friction heat. Also the type of wheel will affect the feed. Generally a soft wheel will not allow as much feed as a hard wheel, but it should be remembered that a hard wheel will burn the faces of the teeth much quicker.

Speed: Most operators run the table at or near maximum speed for sharpening operations. Quality of finish is not materially affected and time is saved. In some instances, however, when a slower work speed is used, precautions should be taken to prevent damage to the hob. A slow speed generates an excessive amount of heat, which will burn and discolor the teeth. If this occurs, the speed should

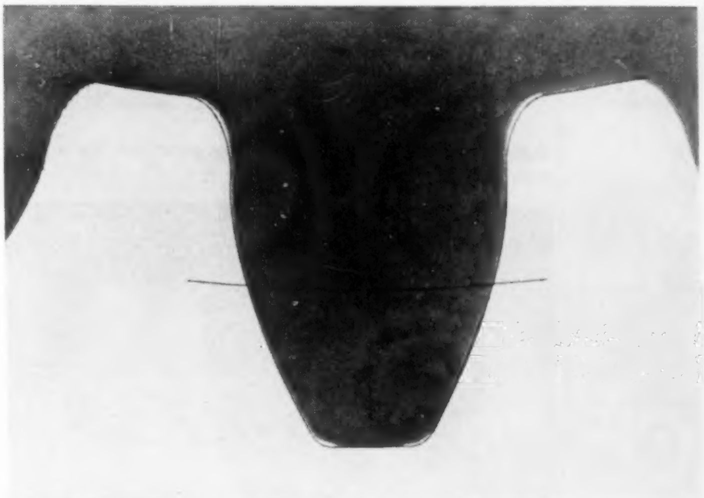
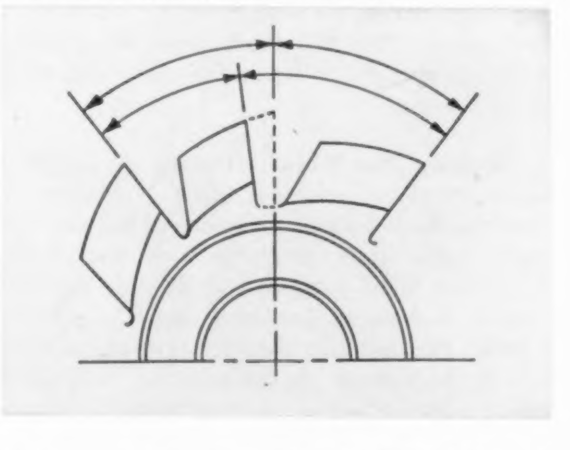


Fig. 6. Profile of a tooth on a gear cut by a correctly sharpened hob.

Fig. 7. Equal spacing of hob flutes must be maintained in sharpening within tolerance.



be increased at once. Burning the faces of the teeth will surface-temper and sometimes anneal the metal, reducing hardness so that a sharp cutting edge cannot be maintained. When finishing the hob by "sparking out," the feed can be shut off and the table speed reduced. Although this will give an excellent finish, it is not necessary in every case. Dur-

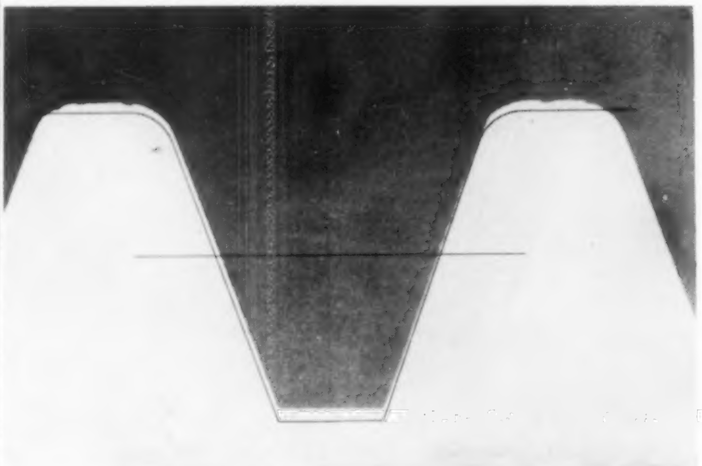


Fig. 8. Profile of a hob tooth with too much stock removed relative to other flutes.

Fig. 9. Profile of a tooth on a gear cut by a hob with a flute spacing error.

ing roughing cuts, the work should be run at fairly high speed. This will break down the grinding wheel, keeping the cutting surface sharp with minimum dressing.

Dressing the Wheel: Dressing the grinding wheel serves two purposes. First, it removes or fractures the dull abrasive particles so that new and sharp cutting edges contact the work; and second, it removes metal particles embedded in the chip spaces. A diamond dresser is used for abrasive wheels. The operation should consist of roughing and finishing steps. In finishing, the diamond is passed over the face of the wheel slowly to give it a fine dressing. The diameter of the wheel is rounded with a carborundum stick to avoid a sharp edge on the wheel.

Grinding Wheels: Practically all hobs made today are either carbide-tipped or of high-speed steel. When selecting a wheel for a particular job, free cutting action and ability to hold shape are of

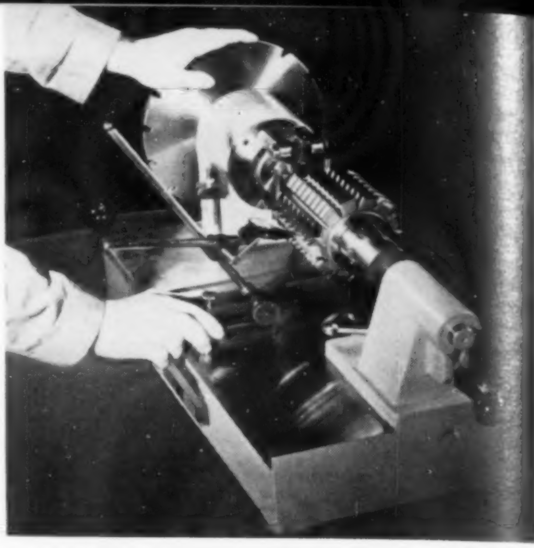


Fig. 10. Hob sharpening checker being used to inspect for radialism and spacing of hob.

paramount importance. Although there are many different types of wheels on the market, it is suggested that a 60 or 80-grit of H or I hardness with B face be used for general purpose sharpening of high-speed steel.

Of course, a diamond wheel must be used for sharpening carbide-tipped hobs. For general purpose sharpening, resinoid bonded wheels of 120-220-grit work well for both roughing and finishing. If a final finish is desired, wheels up to 400-grit may be used. In all cases the concentration of diamonds should be 100.

Wheel Speed: Most sharpening machines are without wheel speed control. The speed of the wheel influences effective wheel hardness. When wheel speed is decreased, the wheel acts soft; when it is increased, the wheel acts hard. The same effect can be obtained by proper selection of wheels so only one speed is necessary.

Coolant: Though many sharpening machines in use have no provision for coolants, it is advisable to use them if possible. While not absolutely essential for sharpening high-speed steel, coolant helps dissipate heat generated at point of contact between wheel and work. It also aids in keeping grinding surface of the wheel clean, reducing loading. In addition, coolants lubricate the surface and give a better finish to the work. When sharpening carbide-tipped hobs, flow of coolant should be started before any contact between work and wheel is made. This prevents surface of the teeth from being heated and then quenched by the coolant.

Setting Up the Machine: Careful attention must be given to the setup of the machine for satisfactory results. The first step is to determine the amount of stock to be removed and to check for chipped or cracked teeth. All data on the hob essential to correct setup should be recorded, such

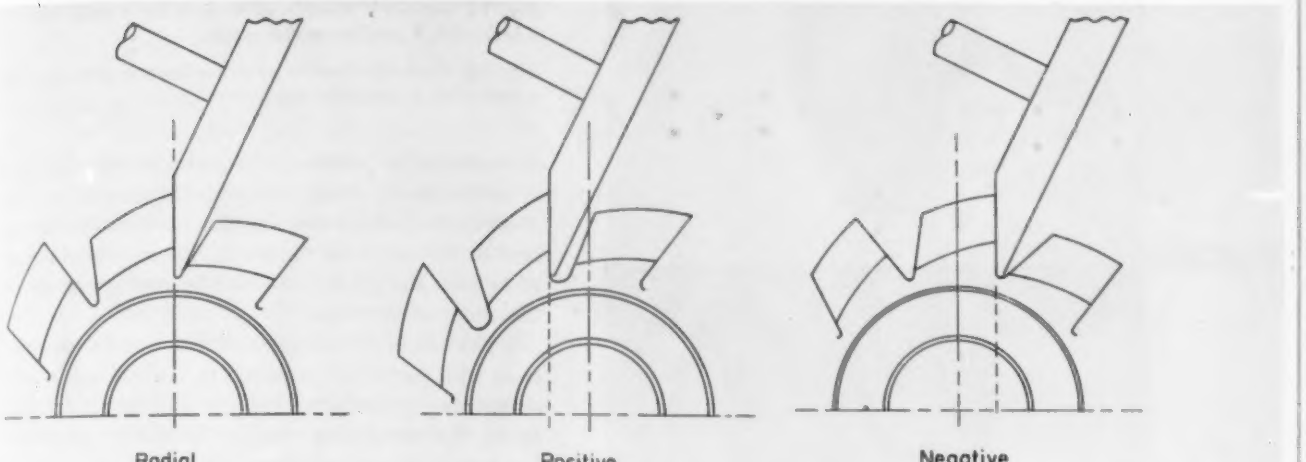


Fig. 11. Hobs designed with radial, positive and negative rake, in order shown.

as number of flutes, amount of offset, lead angle of flute. The next step is to select an index plate with as many notches as there are flutes on the hub. Special care must be taken to remove dirt and burrs from notches, threads and hub. Air should be used in setting the tangent bar to keep the backlash in the proper direction. Runout should be checked on the hubs of the hob after mounting, *Fig.* 4, to be certain they run true within limits for the class and size of the hob.

Types of Sharpening Errors

In a correctly sharpened hob the cutting faces of the teeth all extend to the same outside diameter. Due to the cam relief on the teeth, the diameter becomes smaller with each sharpening. The thickness of the teeth at the cutting face will be the same at any given diameter. This will place the cutting edges of the teeth on the path of the true lead of the thread. When an error occurs in sharpening, however, the cutting edges are displaced from the true lead path so that they remove too much or too little stock, depending on the type of error. The correct hob tooth and a gear tooth formed by it are shown in *Figs.* 5 and 6.

Although the ratio between error on the hob and the error generated in the gear is subject to many variables, an error of 0.016 inch on a 20-deg pressure angle hob results in an error of about 0.001 inch on the gear tooth profile. A round topping hob with the following characteristics was used in each test: diametral pitch, 18; pressure angle, 20 deg; and rake angle 0 deg. The hob was sharpened with each error exaggerated and a pair of gears was cut. All gears were cut to the same OD. Hob and gear teeth are shown enlarged.

Flute Spacing Error: There are two types of spacing error—adjacent, which is flute-to-flute spacing error, and nonadjacent, which is accumulated spacing error between those flutes that give the greatest indicator variation. Maximum flute-to-flute spacing error is defined as the maximum total indicator variation obtained between any two successive flutes. A flute spacing error results when too much or too little stock has been removed from the faces of one or more rows of teeth relative to the other rows, *Fig.* 7. Due to cam relief on the teeth, the

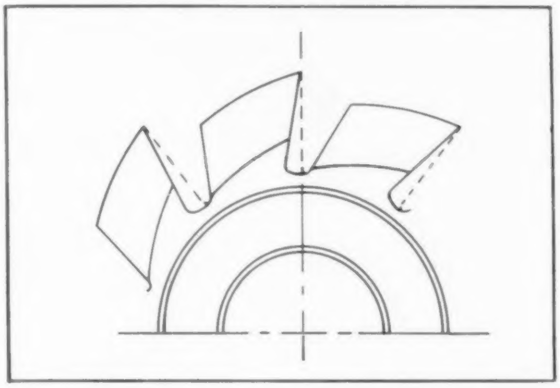
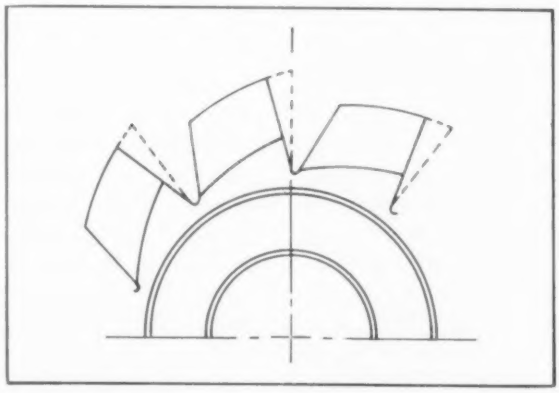
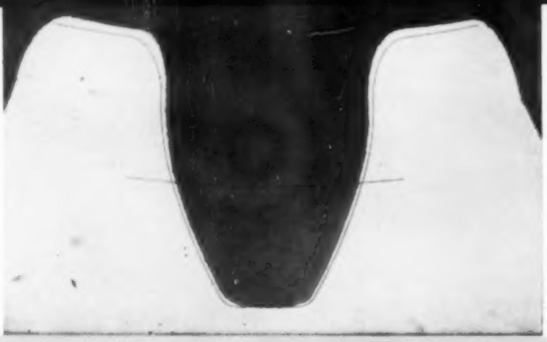


Fig. 12. Positive rake error results when too much stock is removed from lower portion of hob teeth.

Fig. 13. Negative rake error results when too much stock is removed from upper portion of hob teeth.





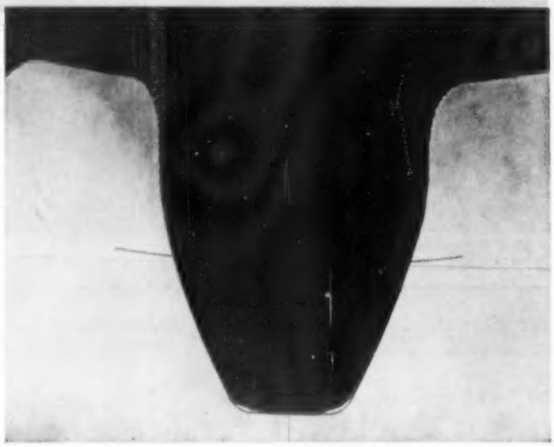


Fig. 14. (upper) Profile of a tooth on a gear cut by a hob with a positive rake error.

Fig. 15. (lower) Profile of a tooth on a gear cut by a hob with a negative rake error.

rows of teeth with too much stock removed from the faces will not extend to the correct outside diameter, and the thickness of the teeth at a given diameter will be less than on the correctly sharpened teeth, Fig. 8. Since the teeth are thinner at a given diameter, the sides of the teeth at the cutting edge are displaced from the true lead. Conversely, the teeth with too little stock removed from the faces will be thicker at a given diameter, which also displaces the sides of the teeth at the cuting edge from the true lead.

Gears which are cut by hobs with flute-to-flute spacing error will not have the correct involute form on the profile, *Fig.* 9. Low spots will be produced by the teeth with too little stock removed from the faces. These teeth extend beyond the correct outside diameter and remove too much stock from the profile of the gear teeth. Hob teeth with too much stock removed from the faces do not extend to the correct outside diameter and consequently do not remove enough stock, leaving a high spot on the gear tooth.

On the sharpening machine, flute spacing errors are caused by runout resulting from dirty and burred centers, loose fit on the arbor or a sprung arbor. They can also be caused by machine misalignment, worn index plate, worn index pawls, a glazed wheel or improper finishing procedures.

To check the accuracy of flute-to-flute spacing on a sharpened hob, use of a hob sharpening checker, *Fig.* 10, is recommended. The index plate must have the same number of notches as there are flutes on the hob, or an even multiple. The indicator is set to zero on the gage block for radial hobs, or to the correct amount of positive or negative rake if the hob is so designed. Using the adjusting screw on the checker, the hob is rotated so that the indicator reads zero at the center of the tooth. Spacing is checked at or near the pitch line which is approximately at the center of the tooth.

If the hob is beyond tolerance, it must be resharpened with particular attention to tooling, setup and sharpening procedure. If it is still beyond tolerances, the sharpening machine should be inspected for misalignment or worn parts.

The important difference in checking the spacing on helical-fluted hobs lies in the handling of the indicator. Indicator readings must always be made in the same fixed plane of rotation or the same position longitudinally along the flute face. This is accomplished with the aid of the guide edge on the base of the checker. This allows the indicator to be moved perpendicular to the hob axis, maintaining the longitudinal position of the indicator.

Nonadjacent spacing error is defined as the maximum indicator variation obtained between any two flutes. Its magnitude is determined by arithmetically adding the flute-to-flute spacing errors for the spaces between those flutes that give the greatest indicator variation. A nonadjacent spacing error will always be as large as or larger than the maximum flute-to-flute error.

Gears which are cut by a hob with a nonadjacent flute spacing error will have the same type of inaccuracies as those cut by a hob with a flute-to-flute spacing error, except that they will show up at various places on the gear tooth profile. The profiles of the teeth will not have the correct involute and the teeth will have high or low spots. Nonadjacent spacing errors are caused by the same conditions which cause the flute-to-flute errors.

When checking the accuracy of nonadjacent spacing, the hob is set up and checked in the same way as flute-to-flute spacing. The setup for checking helical-fluted hobs is the same, but since the thread of the hob advances the longitudinal position of the individual teeth, indicating must often be done between the teeth. This can be accomplished by indicating off the sharpening clearance below the tooth form.

Tooth Face Error: Most hobs are designed and manufactured with radial cutting faces. However, for some special applications they are made with positive rake for good shearing action, or with negative rake where the cutting edge needs backing. Radial, negative and positive rake refer to the position of the tooth face with respect to the axis of the

hob, *Fig.* 11. If the face of the hob tooth were extended and it passed through the axis of the hob, it would be radial. If it were behind the hob axis, it would have positive rake; and if it were in front, it would have negative rake. These terms are also used to designate tooth face errors which occur in sharpening. Positive rake error is used to describe the condition when too much stock is removed from the lower portion of the tooth face, *Fig.* 12. Negative rake error describes the condition where too much stock is removed from the upper portion of the tooth face, *Fig.* 13.

Tooth face error is defined as the total indicator variation when the tooth face is traversed radially from the top to the cutting depth.

The effect of tooth face errors on the profile of the hob teeth depends on the type of face error. Positive rake error produces hob teeth which are longer than normal. The lower portion of the teeth is slightly thinner than normal at any given diameter, reducing the pressure angle. Negative rake has the opposite effect. The hob teeth are short, the pressure angle is increased and the upper portion of the teeth is thinner than normal at a given diameter.

Gears which are cut by hobs with face errors will have an incorrect involute form on the profile. When the gear is cut to the correct depth by a hob with positive rake error, measurement over pins will indicate a deeper cut must be taken. Also, compared to the true involute profile, the tooth has a plus involute at the top of the tooth. However, if a topping hob is used and the gear is cut to the correct outside diameter, a gear tooth as shown in *Fig.* 14 will be produced. The gear tooth is thin and does not have the correct involute form. This situation results because the change in cutting depth to obtain the correct outside diameter is greater than the change required to obtain the correct tooth thickness.

Conversely, when a gear is cut by a hob with negative rake error, measurement over pins will indicate only a slight error. *Fig.* 15 shows a gear tooth cut by the hob with a negative rake error. The tip of the tooth is the correct width as is the outside diameter. The thickness of the tooth increases toward the root and the tooth depth is shallow.

Tooth face errors are usually caused by misalignment of the grinding wheel in relation to the axis of the work. For radial hobs, the face of the grinding wheel should be on a line with the hob axis; for positive rake it should be in front of the axis. These errors can also be caused by misalignment of the diamond to the setting gage or by improper finishing procedures.

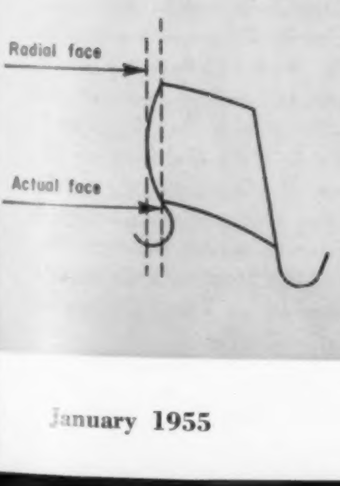
Inspection procedures when checking this phase of hob sharpening are not too difficult. With the hob mounted on the arbor with teeth top-going, the indicator is set. If the hob has radial teeth, indicator is set to zero. If it has either a negative or positive rake offset, micrometer and indicator are set to the amount etched on the hub of the hob. If the angular offset is given, the linear amount can be determined from a table.

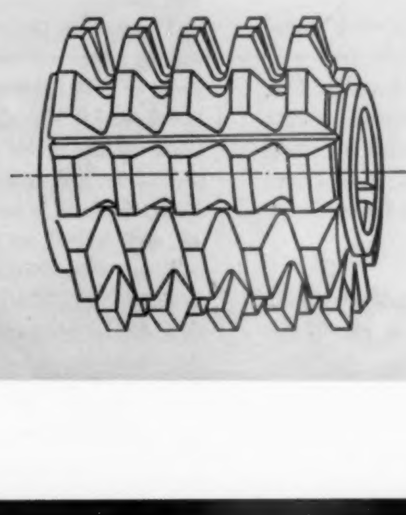
Negative rake offset will be above the center line and positive rake offset will be below the center line of the hub. The indicator is placed against the tooth face at the tip on any tooth except the first one at either end. The hob is rotated until it reads zero. The indicator is moved radially or perpendicularly to the hob axis from the tip to the root of the tooth. On helical-fluted hobs, the guide bar on the base of the checker should be used because the indicator must travel exactly perpendicular to the hob axis for an accurate reading. The total indicator variation is recorded. If it is within the limits for that class of hob, it can be considered radial, or as having the cor-

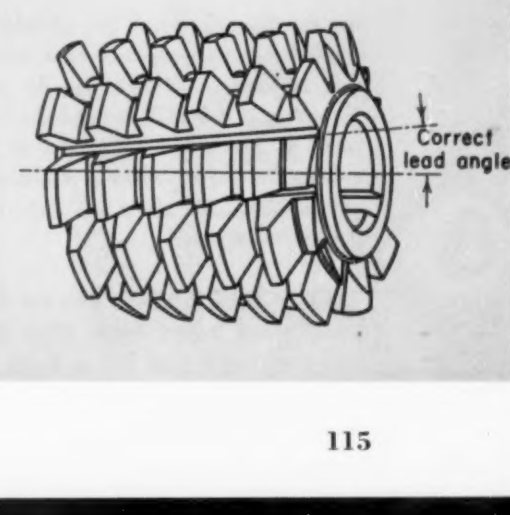
Fig. 16 (left) Convex curve generated on tooth face of helical-fluted hob when wheel is dressed with the straight-line dresser.

Fig. 17. (center) Hob with lead angle of less than 4 deg with straight flutes which must be sharpened parallel to the hob axis.

Fig. 18. (right) Hob with lead angle of more than 4 deg made with flutes normal to lead angle. This hob must be sharpened with the correct flute lead.







rect amount of offset. If it is beyond the tolerances after a recheck, the hob is rotated so that the indicator reads the same at the tip and root of the tooth. The variation from zero on the indicator is the amount for which a correction must be made. If the indicator reads plus, the wheel head on the sharpener will have to be moved back. If it reads minus, the wheel head will have to be moved forward. Also, the alignment of the diamond dresser to the setting gage should be checked. If, after resharpening, the hob is still beyond the tolerances, the sharpener should be checked for proper alignment of the table and centers.

When sharpening helical-fluted hobs with a wheel which has been dressed by the straight-line dresser, a convex curve, *Fig.* 16, will be generated on the face of the hob teeth. It is caused by wheel interference. If, when checking a helical-fluted hob, a convex curve is noticed, the hob is rotated so that the tip and root of the hob read the same, or are parallel to the horizontal center line. If the total indicator variation across the face of the hob is within the tolerance for that class of hob, the curved face is not objectionable and the hob can be considered radial. However, the pitch line will often indicate a positive rake offset, requiring that the face be relocated to bring it within the tolerances. The amount of offset is measured at the pitch line and a negative rake adjustment made on the sharpening machine. After resharpening the hob, the pitch line should indicate a radial condition. If the tip and root are within the specified tolerance, the hob can be considered radial. However, if it is still beyond the tolerances, using a wheel with as small a diameter as possible will help to keep the convex curve to a minimum. If that does not correct it, the wheel will have to be dressed with the helical dresser.

Fig. 19. Profile of a tooth on a gear cut by a hob with a flute lead error.

Flute Lead Error: Hobs are designed with both straight and helical flutes, *Figs.* 17 and 18. If the lead angle on a gear hob is 4 deg or less, the flutes are normally made straight. If it is more than 4 deg, the flutes are usually made normal to the lead angle. Some special hobs are made which deviate from this standard when a different cutting action is desired.

Flute lead error is defined as the total indicator variation when traversing the faces of the teeth, following the specified lead of the flute. Although this element of hob sharpening is important to the accuracy of the gears to be cut, it does not have as much effect as spacing or rake errors since only a small portion of the hob length is used in generating the form on the gear. When shifting the hob, either automatically or manually, the effect becomes more pronounced. A comparison between the gears cut at opposite ends of the hob will show a difference in tooth thickness and depth.

A flute lead error will affect all the teeth on the hob. The teeth will not have the correct profile, and the form will be different on each side of a tooth. Also, the teeth at the end of the hob with most stock removed extend to a smaller diameter than those at the opposite end, making the hob tapered. At a given diameter the tooth thickness becomes progressively thinner toward the small end of the hob. A lead check shows this condition as a long lead on one side of the teeth and a short lead on the other.

Gears cut by a hob with a flute lead error will not have the correct involute form on the profiles of the teeth. The gear tooth is unsymmetric in form, each side of the tooth having a different pressure angle, tending to make the tooth lean, *Fig.* 19.

Flute lead errors are caused by incorrect tangent bar settings, dirty or burred centers, improper finishing procedures, machine misalignment, or worn machine parts.

To check lead accuracy on straight-fluted hobs on a hob sharpening checker, the hob is mounted on the arbor with the teeth top-going, and the indicator set to read zero for radial hobs, or for the correct amount of offset. The indicator is placed against the first full tooth on one end of the hob, and the hob rotated until the indicator reads zero. The indicator is then moved to the first full tooth on the other end. If the difference in readings is within the limit for the class of the hob, it will pass inspection. If it is greater than the tolerance, the setup should be checked and and the hob resharpened.

The lead on helical-fluted hobs must be checked on a lead checking machine in the inspection department or gear laboratory. There is, however, a simple check which the sharpening machine operator can make on the machine. The outside diameter at each end of the hob is measured. If the diameters are the same, the lead is correct. If it is tapered, the lead is off, as the teeth on the end with most stock removed will not extend to the correct outside diameter due to cam relief. The hob should be taken to the inspection department and checked on a lead checker to determine the amount of lead error.

THE TOOL ENGINEER
REFERENCE SHEETS

Carbide Grades

Equivalent Carbide Grades

Data courtesy

Tungsten Alloy Mfg. Co., Inc., Newark, N. J.

WHENEVER more than one designation exists for similar materials, confusion and improper substitution can result. There are ten major producers of carbides and each producer has several grades. The table below indicates the equivalency of the grades of various manufacturers as indicated by their own recommendation.

For chip removal applications on cast iron and nonferrous materials: C-1 is used for roughing cuts; C-2 is used for general purposes; C-3 is used for light finishing cuts; and C-4 is used for precision boring. When removing chips from steel: C-5 is used for roughing cuts; C-6 is used for general purposes; C-7 is used for finishing cuts; and C-8 is used for precision boring.

In wear surface applications: C-9 is used where no shock will be encountered; C-10 is used where light shocks are possible; and C-11 is used where heavy shocks are anticipated. In applications involving impact: C-12 is used where impacts are light; C-13 is used where impacts are medium; and C-14 is used where impact can be heavy.

Manufacturers' Recommendation for Standard Grades

	Symbol	Tungsten Alloy	Adams	Carboloy	Carmet	Firthite	Kennametal	Talide	Vascoloy Ramet	Wesson	Willey
Chip Removal Application	C-1	9	B	44A	CA-3	H	K6	C80	2A68	GS	E-8
	C-2	9-H	A	883	CA-4	HA	K6	C91	2A5	GI	E-6
	C-3	9-C	AA	905	CA-7	HE	K8	C93	2A7	GA	E-5
	C-4	9-B	AA	999	CA-8	HF	K8	C93	2A7	GF	E-3
	C-5	9-R	DD	78B, 78C	CA-5, CA-51	T04, T85	K2S, KM	S88	EE	WS	945
	C-6	9-G	D	78, 78B	CA-1	TA, T81	K2S	S90	EM	WM	710
	C-7	9-F	C	78	CA-2	T16, T19	K3H	S92	E	WH	606
	C-8	9-F	CC	831	CA-6	T31	K5H	S92	EH	WH	509
Wear Application	C-9	9	A	44A, 883	CA-4	HA	K8	C89	2A5	GI	E-6
	C-10	9-M	B	779, 44A	CA-3	H	K6	C88	2A68	GS	E-8
	C-11	9-A	HD-20	55A, 55B	CA-10	HC	K1	C8815	2A3	M	E-18
Impact Application	C-12	9-A15	BB	44A, 55A	CA-10	DC-2	K1	C8815	2A3	GS	E-13
	C-13	9-A20	HD-20	55A, 55B	CA-11	DC-X	K18	C8020	AX	M	E-18
	C-14	9-A25	HD-25	190	CA-20	DC-3	K25	C7525	AY	M	E-25

General Formula for Pin Measurement of Gears

Data courtesy **Size Control Co., Chicago, Ill.**

COMPUTATIONS of pin measurements are based on the pin contacting some part of the active profile of the gear teeth, generally at or above the pitch line. The contact point varies with the number of teeth and the pin diameter. The choice of pitch diameter is arbitrary and may be at the standard pitch diameter or above it. This is of no practical consequence because involute gears have no fixed pitch diameter until they mesh with another gear or a rack.

Of the several current pin measurement systems, that using a 1.728-inch pin at one diametral pitch is most common because measurements can be made with standard micrometers on gears of standard outside diameters having a wide range of backlash.

The formulas for pin measurement given here are simple and can be used with any spur or helical gears having any pressure angles. The diameter of the pin can be computed for the 1.728-inch pin or any other by substitution in the third formula.

Formulas

$$\tan\varphi = \frac{\tan\varphi_n}{\cos\psi}$$

$$D_b = D\cos\varphi$$

$$d = \frac{1.728}{P_n}$$

$$T_{ns} = \frac{\pi}{2P_n} = \frac{1.5708}{P_n}$$

$$\Delta T_n = T_{ns} - T_n$$

$$\text{inv}\,\varphi = \tan\varphi - \left(\frac{\pi\varphi}{180}\right)$$

$$\text{inv}\,\varphi_m = \frac{1}{N}\left[dP_n\sec\varphi_n + N\,\text{inv}\varphi - \Delta T_n P_n - 0.5\pi\right]$$

$$D_m = \frac{D_b}{\cos\varphi_m} + d \quad \text{(even toothed gears)}$$

$$D_m = \frac{D_b}{\cos\varphi_m}\cos\frac{90}{N} + d \quad \text{(odd toothed gears)}$$

EXAMPLE: Determine measurement over pins for a spur gear with the following characteristics:

$N = 24$ teeth	$D = 0.500$ inch
$P_n = 48$	$D_o = 0.550$ inch
$\varphi_n = 20$ deg	$T_n = 0.03636$ inch

SOLUTION: Since a spur gear is a helical gear with a helix angle equal to zero:

$$\varphi = \varphi_n = 20 \text{ deg}$$

$$D_b = 0.500\cos 20 = 0.46985$$

$$d = \frac{1.728}{48} = 0.036 \text{ inch}$$

$$T_{ns} = \frac{1.5708}{48} = 0.03272 \text{ inch}$$

$$\Delta T_n = 0.03272 - 0.03636 = -0.00364 \text{ inch}$$

$$\text{inv}\,\varphi = 0.36397 - \frac{20\pi}{180} = 0.0149$$

$$\text{inv}\,\varphi_m = \frac{1}{24}\left[(0.036)(48)(1.06418) + (24)(0.0149) - (-0.00364)(48) - 0.5\pi\right] = 0.03335$$

$$\varphi_m = 25.86 \text{ deg}$$

$$\cos\varphi_m = 0.89986$$

$$D_m = \frac{0.46985}{0.89986} + 0.036 = 0.5581 \text{ inch}$$

Measurement over pins for a helical gear would be determined in the same way, except that the helix angle would be given and the pressure angle in the plane of rotation would have to be computed.

Nomenclature

D = Standard pitch diameter, inch
d = Diameter of measuring pin, inch
D_b = Base diameter, inch
D_m = Measurement over pins, inch
D_o = Outside diameter, inch
N = Number of teeth
P_n = Normal diametral pitch
T_n = Normal tooth thickness on standard pitch diameter, inch
ΔT_n = Change in tooth thickness from std, inch
T_{ns} = Standard normal tooth thickness, inch
φ = Pressure angle in plane of rotation, deg
φ_m = Pressure angle at center of measuring pin, deg
φ_n = Normal pressure angle, deg
Ψ = Helix angle at standard pitch diameter, deg

NEWS

Dean of Engineering Addresses Vocational Guidance Meeting in Detroit
. . . see page 121

featured this month

chapter news

A NEW phase of ASTE communication was launched in November when the first issue of the *Delegates' Newscaster* was sent out by National Headquarters. Designed primarily as a service for the Society's National Delegates, the *Newscaster* also serves as a capsule news report for all other members of the national family.

NOT intended as a substitute for the regular headquarters mail (visitation reports, mail ballots, special letters, committee reports, etc.) that goes out every day to the National Delegates, chapter chairmen, national officers, directors, committee chairmen and committee members, the *Newscaster* is instead, a supplement to all other media employed to help the national family "Keep Posted."

ONE suggestion for its use which has stimulated much interest is the idea of using the *Newscaster* as a fact sheet for short discussions at chapter meetings. If a few minutes were set aside at each meeting for the National Delegate's report, members would have an opportunity to review what is being done at the national level to further the aims and goals of the Society. This would also be an effective way for chapters to secure additional ideas on programs and special events they might have in conjunction with national projects.

Encouragement to enter the tool engineering profession was given by Detroit ASTE chapter members. Pictured at the head of the table, from left, are: Walter Schober, Edward Novak, Stanley Phillips and Anthony Rogers.

Detroit Students Counseled on Engineering Opportunities

As evidence of the unlimited opportunities open to young men and women in engineering, representatives of ASTE and 23 other engineering organizations offered counseling services at the 20th Annual Engineering and Science Vocational Guidance Meeting held November 30 in Detroit. The program was sponsored by the Engineering Society of Detroit in cooperation with the City of Detroit Board of Education.

More than 700 high school students from the area, selected by their advisors for having interests and abilities in engineering, were excused from classes to attend the meeting. They were urged to bring a member of the family or close adult friend with them. Counting adults, attendance was close to 1,000.

The meeting, held at Rackham Educational Memorial Building, was opened with an address by Dr. John Douglas Ryder, dean of the School of Engineering at Michigan State College. After his message students visited as many different groups of counselors as they wished and talked to the society representatives about various fields of engineering.

ASTE counselors were from the Detroit chapter of the Society. They were: Stanley Phillips, chapter chairman; Anthony S. Rogers, secretary; Edward Novak, chairman of the constitution and by-laws committee; and Walter Schober, chairman of the public relations committee. They were among 100 engineers, both men and women, who gave their time and experience freely as a public service to advance their professions by attracting young people naturally fitted for such work. National sponsor of the meeting was the Engineers' Council for Professional Development.

Participants at the guidance meeting included, from left: Earl Bartholomew, president of the Engineering Society of Detroit; Dr. John D. Ryder, dean of the school of engineering at MSC; Miss Virginia Sink, project engineer at Chrysler Corp.; William E. Stirton, vice president of Wayne University; Mrs. Elsie McGough, chairman of the Detroit section of Women Engineers; Dr. Harold Donnelly, head of the chemical and metallurgical engineering department at Wayne University; A. Richard Meacham, general engineering personnel supervisor for Michigan Bell Telephone Co.; and S. N. Horton, Guidance and Placement Division of the Detroit Board of Education.

INDUSTRIAL REVIEWERS

evaluate material for *ASTE Die Design Handbook*

By Nancy M. Houston, News Editor

As the publishing date of the *ASTE Die Design Handbook approaches,* it is interesting to note the careful planning that has gone into this work to insure maximum utility with complete accuracy. Not only has the arrangement of material been planned to induce concentration on a particular problem, but well-qualified industrial reviewers have evaluated all the material that will be published.

Information was gathered from industry, and processed by a team of handbook editors familiar with the problems of die design. Manuscripts of each section were submitted to reviewers in industry who, because of their immediate interest and experience, could check the accuracy and utility of the proposed information. Prior to publication, all material was again reviewed by the editors and members of the ASTE National Book Committee.

Industrial reviewers were chosen because of their familiarity with a particular phase of die design or use and because of their ability to evaluate the practical shop use of the information. The following are typical and represent the scope and authority of the reviewers as a group.

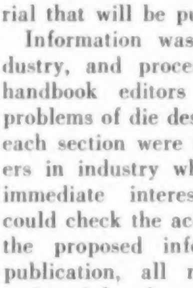
John S. Brozek is superintendent of the Tooling and Maintenance Div., Sargent & Co., New Haven, Conn., where he is in charge of tool engineering, plant engineering, the plant maintenance and machine shop, and the tool design and pattern shop. A mechanical engineering graduate of McKinley-Roosevelt College, he has a diversified background in production engineering, manufacturing and tooling in arms and ammunitions components, electronics, and builders' hardware and tools. He was formerly associated with the Auto Ordnance Corp., Bridgeport, Conn., as chief engineer; Maguire Industries, Bridgeport, as director of mechanical operations and as tool superintendent; and with Winchester Repeating Arms Co., New Haven, Conn., in a number of capacities. Mr. Brozek is now chairman of the New Haven ASTE chapter and also holds membership in ASME. He is a lecturer on die design problems and is a contributor to THE TOOL ENGINEER magazine.

Elliott C. Clifford, superintendent at the Engleside Tool and Mfg. Co., Detroit, Mich., has had 35 years of experience in sheet metal tooling design and production. He was instrumental in developing and producing the first all-steel automobile body for the "Flanders 20." On special assignment with the General Motors Research Department, he developed unusual sheet metal tooling, such as radiator air coring, for the "gold-plated" Cadillac. His more recent experience includes automation for the production of Plymouth hoods. He was a member of the authors' committee for the Punch and Die Section of the *Tool Engineers Handbook.*

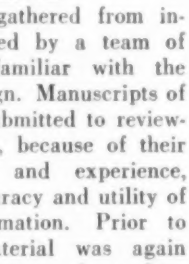
Charles R. Cory is senior engineer in charge of die engineering at the Fisher Body Division of General Motors Corp. in Detroit. A graduate of Case Institute of Technology in Cleveland, with a degree in mechanical engineering, he also attended Heidelberg College in Tiffin, Ohio. Mr. Cory, who joined Fisher Body in 1928, has taught die designing at the University of Detroit, written for various technical magazines and published two books on the subject. He has addressed various engineering societies on die engineering problems.

E. W. Ernst, who started out as a machinist apprentice in 1913, has had more than 40 years of industrial experience to his credit. Now manager of GE's machine tool equipment planning at Louisville, Ky., his association with General Electric has been continuous except for a period from 1922-1924 when he formed his own company and later did electrical design work for the New York Edison Co. Mr. Ernst has taught classes at GE on lathe work, practical welding, supervisory training, metallurgy and several other subjects. He was awarded a Life Membership in ASTE at the 1947 annual meeting for his work as chairman of the National Book Committee which produced the *Tool Engineers Handbook.* After helping to establish the Schenectady ASTE chapter, he served as its chairman and later became head of the National Standards Committee. He is a member of ASME.

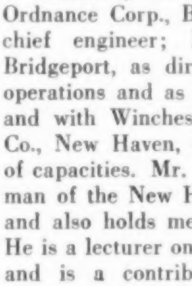
J. Walter Gulliksen is factory manager and a member of the Board of Directors at Worcester Pressed Steel Co., Worcester, Mass. Before joining



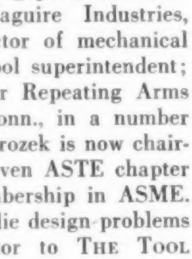
Brozek



Clifford



Cory



Ernst

firm in 1942 as assistant to the ...eral manager, he spent about 15 ...s with the Aluminum Co. of Amer... working principally in the field of ...al stampings and impact extrusion. ...mechanical engineering graduate of ...vens Institute of Technology, Mr. ...lliksen did postgraduate study at ...w York University. He is author of ...hnical articles which have appeared ... a number of engineering and indus...ial publications. He is a registered ...ofessional engineer, a member of ...STE and ASME, and served as chair...man of the Worcester chapter of ASM.

Norman J. Kirk is vice president of the E. W. Bliss Co., Toledo, Ohio. Elected to that post in 1950, he previously served as general manager of the company's Toledo Division. Mr. Kirk began his career in 1917 as an errand boy at the National Cash Register Co. and a year later began training as a tool and die maker. His supervisory experience includes work as foreman for G. M. Radio, Dayton; tool and die superintendent at Electric Auto Lite Co., Bay City, Mich.; plant superintendent at Republic Steel Corp., Elyria, Ohio; works manager at Standard Steel Spring Co., Allegan, Mich.

John W. Lengbridge is project engineer at Aluminum Goods, Ltd., Toronto, Ontario, Canada, where his responsibilities include postwar and current production projects. A registered professional engineer, his industrial experience goes back to 1910 when he began shopwork in foundry, plating, finishing and toolroom departments. He has been associated with Canadian Aeroplanes, Ltd., United Brass and Tool Co., Northern Aluminum Co., Ltd., and Aluminum Co. of Canada, Ltd. Mr. Lengbridge joined his present company as design engineer and later became production superintendent on products. An active member of ASTE, he has served on national committees and lectured widely at chapter meetings. He has taught die design at Ryerson Institute of Technology in Toronto and is a member of the advisory board for the school. He holds membership in ASME, ASM and the British Institute of Metals.

J. R. Paquin is chief engineer of the Worcester Automatic Machine Co., Worcester, Mass. Formerly a die design instructor at the Porter School of Tool and Machine Design, Hartford, Conn., he is well-known in the technical writing field, with more than 50 published articles to his credit. Mr. Paquin completed his engineering studies at Lowell Technological Institute in 1940 and since then has held engineering positions at a number of manufacturing plants, including Frigidaire Div. of General Motors Corp.,


Gulliksen


Kirk


Lengbridge


Paquin

National Can Corp., Associated Engineers, and Crompton & Knowles.

George A. Roberts, who has published a number of technical papers and a book on tool steels, is vice president in charge of technology at Vanadium-Alloys Steel Co., Latrobe, Pa. He is a graduate of Carnegie Institute of Technology where he also received his M. Sc. and D. Sc. degrees. He also attended the U. S. Naval Academy at Annapolis for two years. Dr. Roberts joined Bell Telephone Laboratories as a laboratory technician in 1938 and three years later became associated with Vanadium-Alloys, first as research metallurgist and then chief metallurgist. A member of several technical societies, he is president of ASM, national director of the Metal Powder Association, and vice chairman of the ASA-ASTE Committee B-52 on standardization of materials for tools, dies, gages, and fixtures.

George Sachs is director of the metallurgical research laboratories at Syracuse University, East Syracuse, N. Y. Educated in Berlin, Germany, he received his D. Eng. degree in mechanical engineering and began his career as a professor of metallurgy in 1928. In the following eight years he held several posts in Germany, including positions as director of metals research and vice president in two industrial firms. In 1936 Dr. Sachs came to the United States to join Baker and Co., Newark, N. J. He was later associated with Case Institute of Technology as professor and director of the metals research laboratories, and then became a consulting engineer and president of Metals Research Associates in Cleveland. Still an engineering consultant, he is a member of several technical societies, has lectured widely, written many articles and is author of *Principles and Methods of Sheet Metal Fabrication.*

E. Von Hambach is research and development engineer at The Carpenter Steel Co., Reading, Pa. His experience in the fabrication of metals is broad and varied and dates back almost 25 years, to the time when stainless steels were first being thought of commercially in this country. Author of *Notebook on Machining Stainless Steels,*


Roberts


Sachs


Von Hambach


von Brecht

Mr. Von Hambach pioneered the first use of stainless steel in the automotive, aircraft and refrigeration industries. He received his education in the U. S. and Germany, and began his industrial experience as an automobile mechanic. After designing and building race cars for a few years, he shifted to research engineering in the applications of stainless steels when he joined Carpenter in 1928. Active in ASTE, he holds memberships in ASM, ASTM and the Engineering Society of Detroit.

Forrest G. von Brecht is manager of the Manufacturing Engineering Division of White-Rodgers Electric Co., St. Louis, Mo. Under his direction the design and building of all tooling for the manufacture of civilian products is carried out. He is also in charge of the standard time section, the methods engineering section and the industrial engineering section. He holds a B.S. degree in engineering from Harvard University. A professional engineer, Mr. van Brecht is a member of the Missouri and National Professional Engineering Societies. Other memberships include those of ASTE, St. Louis Engineering Club and the American Welding Society.

On-Campus Conferences

Lehigh University

ASTE members attending Lehigh University's conference on November 13 learned about developing engineers into manufacturing executives, improving production through tools and dies, and uses of plastics in tooling. A session devoted to foundry practice included an exhibit of castings, left, which attracted much attention during the informal discussion period.

The lecture on developing manufacturing executives was delivered by R. F. Pearse, standing, who is senior associate of Worthington Associates in Chicago. Other speakers included: Dr. Harry B. Osborn, Jr., first vice president of ASTE; and A. V. Bodine, president of Bodine Corp.

Participating in the panel on foundry practice were: W. T. Marshall, superintendent, Doehler-Jarvis Div., National Lead Co.; Herman Good, plant manager, Reading Textile Machine Co.; Werner Miller, chairman of Lehigh Valley ASTE chapter; Art Diamond, moderator, past chairman of the National Education Committee; Truman Coy, chairman of Greater Lancaster chapter; Max Wendt, vice president of engineering, Arwood Precision Investment Casting Co.; and William Thomas, vice president, Emmaus Foundry & Machine Co. The conference was opened by Dean L. V. Bewley of the Engineering School.

"Planning for Tomorrow's Cost Reduction" was the theme of the University of Michigan's November 20 conference. Speakers included: Charles Hautau, president of Hautau Engineering Co.; Prof. L. V. Colwell, of the university's production engineering department; Charles Smillie, a national director of ASTE and president of the C. M. Smillie Co.; and Charles Clark of Cincinnati Milling Machine Co.

University of Michigan

Guest speaker at the evening dinner was T. A. Boyd, of General Motors Research Laboratories.

Three University of Michigan staff members compare notes at the conference luncheon. From left are: Dean G. G. Brown; Prof. O. W. Boston, head of the Department of Production Engineering; and Prof. R. E. McKee, who is also chairman of the ASTE National Education Committee.

At the head table are: Raymond C. W. Peterson, ASTE national secretary; H. Dale Long, assistant secretary-treasurer of ASTE; Charles Smillie, a national director of ASTE; and Stanley Phillips, chairman of the Detroit ASTE chapter during the noon luncheon.

On-Campus Conference

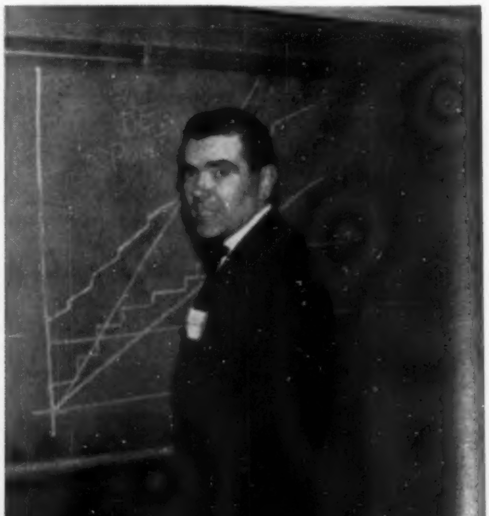
University of Iowa

The University of Iowa held its first conference on November 13. Following a morning session, participants talk over some points brought out. From left are: Prof. J. Wayne Deegan of the university; Mario Vanni, staff industrial engineer, Deere & Co.; Prof. Robert McKee, chairman of the ASTE National Education Committee; and G. L. Weissenburger, president of Keouk Electro-Metals Co.

The head luncheon table at Iowa's conference on "Controlling the Immeasurable" included from left: Prof. R. E. McKee, chairman of the ASTE National Education Committee; J. P. Crosby, national ASTE president; E. R. Saunders, assistant news editor, THE TOOL ENGINEER; C. F. Bryant, chairman of Cedar Rapids chapter; Dean F. M. Dawson; Dr. Hew Roberts; Prof. J. W. Deegan; and H. M. Fitch.

Speakers at the afternoon session included: Joseph Kosinski, factory manager, Scully-Jones & Co.; D. J. Driscoll, manufacturing division comptroller, Collins Radio Co.; and G. A. Johnson, plant extension engineer for Northwestern Bell Telephone Co. of Des Moines.

Prof. Daniel L. Sweeney of the University of Iowa's Accounting Department, makes a few sketches on the blackboard during an afternoon session. He participated in a panel discussion on "Control of Fixed Costs."



ASTE Research Fund Committee

Investigates Metal Cutting

Although much valuable work has been published and even more has been done by individuals and research teams in the field of machinability, insufficient study has been done to learn how and why successful machining operations have been successful. In general, individual projects have been initiated to determine the optimum conditions for a specific metal-cutting operation. Once the desired conditions are known, they are put into practice and the investigation stops. This has resulted in isolated information on specific cutting operations through which many parts have been made with real savings. However, when a new set of factors are introduced, a complete program of investigation is necessary.

The ASTE Research Fund Committee, in its most ambitious project to date, is going to offer the leadership for a concerted attack on the problems of metal cutting. A project has been set up to determine if basic theories of metal cutting can be developed. If it appears that theories can be developed, the project will encourage work in this field so that basic principles can be stated and proved.

Knowing proven principles of metal cutting, tool engineers can attack future problems encountered in product manufacture from a sound basis. Machinability investigations will be either unnecessary or drastically reduced in scope.

Benefits will accrue to others besides the tool engineer group. Knowing what happens when metal is cut, understanding why specific metallurgical structures can be cut as they can, understanding why free machining metals act the way they do and learning how each variable affects the end result, will benefit all producers and users of metal products. Tool steel, cutting tool, machine tool, basic metals and cutting fluid producers could all turn out better products that would lead to faster more economic production.

To carry on a project of such scope requires competent and unified direction. To insure a variety of skills and experiences, the Fund Committee has secured the services of a group of men who will act as a steering committee (see box) for this project. Under the guidance of the Fund Committee and with the assistance of its research director, L. S. Fletcher, the Steering Committee will be responsible for the active direction of this project.

Actual work is already underway and a preliminary plan of action has been formulated. Existing sources of information, published or not, will be investigated, evaluated and collated. Researchers and research organizations known to be working in any section of this field will be contacted and invited to cooperate with the project.

When the gaps in current information are known, activities of the project will change. The Steering Committee will, with the cooperation of industry, attempt to fill in the missing information that will lead to the stating and proving of fundamental metal-cutting laws.

Metal Cutting Steering Committee

Dr. George Roberts
Vice President of Technology
Vanadium Alloys Steel Co.
Latrobe, Pa.

E. L. Fowler
Development and Research Div.
The International Nickel Co., Inc.
New York, N. Y.

Charles F. Vandekerck
Staff Master Mechanic
Chrysler Corp.
Highland Park, Mich.

A. O. Schaefer
Vice President
Midvale Co.
Nicetown
Philadelphia, Pa.

E. M. Barber
Research Supervisor
Beacon Laboratories
The Texas Co.
Beacon, N. Y.

E. J. Kaiser, Manager
Davis Boring Tool Div.
Giddings & Lewis Machine Tool Co.
Fond du Lac, Wis.

Lewis E. Thelin
The Bristol Brass Corp.
Bristol, Conn.

David N. Smith, Manager
Leif Fersing (Alternate)
Research Div.
Jones & Lamson Machine Co.
Springfield, Vt.

Special guests at Piedmont's anniversary celebration, from left, were: F. R. Lack, vice president of Western Electric; H. B. Osborn, Jr., ASTE first vice president; J. P. Crosby, ASTE president; F. R. Kappel, president of Western Electric; S. B. Jeffreys, Piedmont chapter chairman; and F. E. Henderson, works manager for Western Electric's North Carolina Works.

Piedmont's Anniversary Proclaimed Tool Engineers' Day in North Carolina

Proclaimed Tool Engineers' Day by the governor of North Carolina and the mayor of Greensboro, N. C., November 8 marked the fifth anniversary of Piedmont chapter and the event was celebrated with a special birthday program. More than 300 members, key industrial representatives, local and state officials and national officers of ASTE participated in the program. Representing the Society's national family were Joseph P. Crosby, president, and Harry B. Osborn, Jr., first vice president.

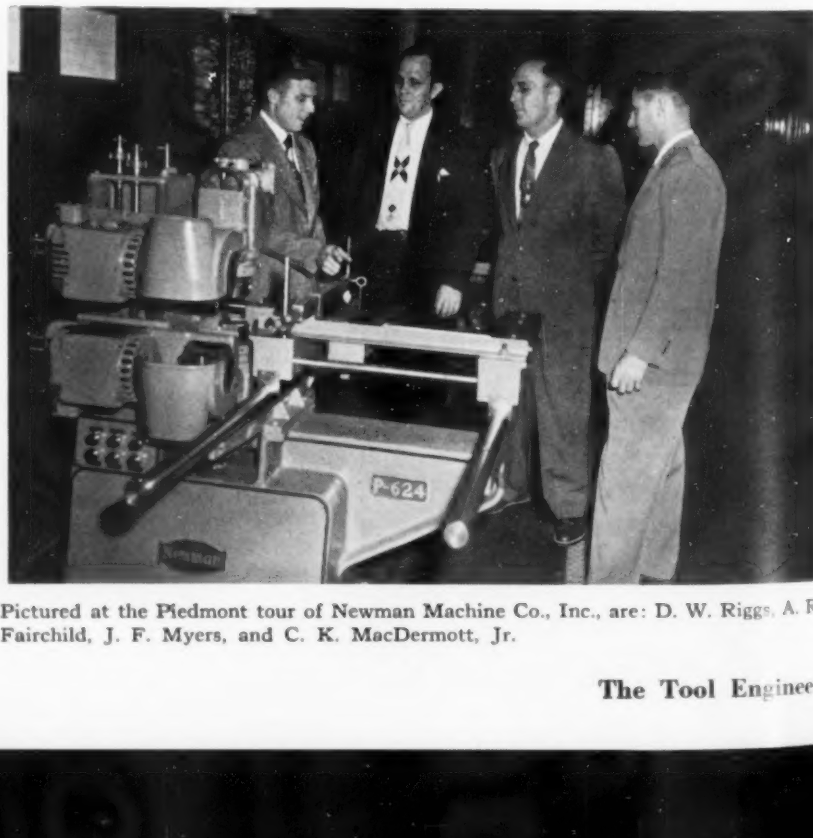
Highlighting the day's activities, which included tours of various manufacturing plants in the area, was a banquet address made by Frederick Kappel, president of Western Electric Co., Inc., New York, N. Y. In his speech on "The Tool Engineer's Role in Modern Industry," Mr. Kappel paid tribute to the contribution of tool engineers to the spectacular progress in modern manufacturing.

"This has been without doubt a decisive factor in our nation's industrial leadership over the world," he said. Emphasizing the importance of tool engineers, not only to Western Electric but to every industry, he cited the outstanding job that has been done at the company's plants in North Carolina.

Mr. Kappel also stressed "the inseparable relation between tool engineers and effective production." He said, "I credit our accomplishments to good engineering, good organization, and the opportunities of the private enterprise system. That is why in the United States we have the highest standard of living and more leisure time than anywhere in the world."

Introductory remarks prior to Mr. Kappel's address were delivered by William T. Polk, associate editor of the *Greensboro Daily News*. He delighted his audience with anecdotes about the South in general and one in particular which, he said, showed one of the reasons the South lost the Civil War was because it didn't have enough tool engineers.

The fifth anniversary celebration was heralded by a special message for the chapter's November bulletin written by Chairman S. B. Jeffreys. He traced the history of tool engineering since the founding of the Society, described the definition of the profession, and told of the wide opportunities for advancement open to tool engineers because of their key placement in industry.



Pictured at the Piedmont tour of Newman Machine Co., Inc., are: D. W. Riggs, A. R. Fairchild, J. F. Myers, and C. K. MacDermott, Jr.

Chief Engineer Talks at Memphis Meeting

W. L. Kennicott, chief engineer of Kennametal, Latrobe, Pa., was the guest speaker at the November [illegible] meeting of the Memphis chapter. Some 55 members and guests at the King Cotton Hotel heard his discussion of "Carbide Tool Trouble Shooting" which was illustrated by slides. He covered equipment needed, possible causes of trouble and remedies.

On October 8, Robert Moore of Moore Equipment Co. in Indianapolis was the featured technical speaker. He presented a motion picture and talk on all types of automatic feeding devices.

—*Frank Fl*

M. P. Tregnan Speaks at Los Angeles Meeting

Guest speaker at the Los Angeles chapter's November 11 meeting was Martin P. Tregnan, West Coast representative for Metal Parts and Equipment Co. of Cleveland. He chose as his topic, "Frozen Mercury Investment Casting."

Mr. Tregnan compared the lost wax and frozen mercury methods of investment casting, pointing out that larger investment castings can be made with the latter method. He showed examples of castings 20 inches in diameter and 38 inches high and stated that castings up to 42 inches were made with frozen mercury patterns.

The nominating committee consisting of Ben J. Hazewinkel, a national director, Tony Peck and Ralph Chrissie of the National Membership Committee, was selected.

A color sound film of the power boat races held at Seattle each year was shown after the technical session and 36 new members who signed up in October were introduced and given a hearty round of applause.

—John Boettgenbach

Compressed Fluid Uses Discussed at Schenectady

John C. Kosky, director of public relations for Wales-Strippit Corp., North Tonawanda, N. Y., was the technical speaker at the November meeting of Schenectady chapter. His talk on "Compressed Fluid Application for Industrial Tools" was heard by an audience of 23 members. Mr. Kosky spoke about the use of hydraulic cushions in punching operations.

On the business side, George S. Nelson was elected treasurer of the chapter to replace Leo A. Shea who has moved to Binghamton.

—George S. Nelson

Western Michigan Speaker Reviews Precision Boring

A paper on "New Arts in Precision Boring" was presented at Western Michigan's November meeting by Charles B. DeVlieg, president of DeVlieg Machine Co., Detroit, Mich. Covering the merits of the jig mill in considerable detail, Mr. DeVlieg listed the ten commandments of boring to be followed for holding close tolerances.

Guests attending the meeting held at the Varsity Grill in Grand Rapids were: Jon Adams, O. D. Bitnar and Art Oettmeier, all of Ferris Institute at Big Rapids, Mich.

—Jim Rost

LEADERSHIP AWARD—Roger F. Waindle, left, past president of ASTE, recently presented a plaque to Kenneth M. Bartlett, division manager of Thompson Products, Inc., in recognition of his outstanding service and leadership as first president of the Investment Casting Institute. Mr. Waindle is head of Wai Met Engineering Co.

H. L. Stewart Presents "Fluid Power in Action"

Northern Massachusetts members learned about components, circuit problems and applications of air and hydraulics in regard to industrial equipment, at their November 16 meeting. An audience of 84 was present to hear a talk by H. L. Stewart, assistant sales manager of the Logansport Machine Co., Logansport, Ind.

New chapter members, accepted by the executive committee on November 11, include: Donald W. McCurda, Neil J. Henrich, Thomas Copeland, Allan B. Carruth, Donald L. Hover, John Holston, Ralph Younger, William Reilly, and Robert Holloway. *—Otto S. Nau*

W. O. Johnson Addresses Niagara District Chapter

A discussion on "Flame Plating with Tungsten Carbide" was presented November 4 at a meeting of nearly 90 Niagara District members and guests. Technical speaker was W. O. Johnson of the Dominion Oxygen Co., Ltd., Toronto, Ont.

In his talk, he described the various characteristics and properties of tungsten carbide, and told about its many applications. He was introduced by Ralph Meeker. Hosts for the evening's program were the Lightning Fastener Co., Ltd., and Conroy Mfg. Co. of St. Catharines. The meeting was held at the Queensway Hotel. *—C. R. Mitchell*

DoAll Exhibit Shown at South Bend Meeting

C. G. Schelly, research director of the Wilkie Foundation, was the guest speaker at South Bend's October meeting. He served as the narrator for the DoAll display on "Civilization Through Tools," which shows how man's survival, his development and material welfare are considerably dependent on tools.

Typical of the many fascinating items in the exhibit were stone age tools approximately 500,000 years old and colonial muskets produced for the first time on a production basis by Eli Whitney.

An audience of 94 members and guests was on hand to view the well-traveled display. The meeting was held at the Isaac Walton League.

—Dave Herring

SOUTH BEND PROGRAM—Highlight of the October meeting was the exhibit sponsored by DoAll. Explaining a display panel is C. G. Schelly, left, of the firm's research staff. With him are: E. James Nelson, second vice chairman; Harold Houseworth, chairman; and John R. Berker, first vice chairman.

Rochester Awards $800 Scholarship

With ASTE President Joseph P. Crosby in attendance, Rochester chapter presented its annual scholarship worth $800 at a meeting held on November 2. Recipient of the award was Robert Conway, Navy veteran and graduate of Aquinas Institute, who plans college study in the field of tool engineering. This year's scholarship was made possible with the help of many Rochester industries who have joined the Society as affiliate members.

In addition to the presentation, the meeting was highlighted by a panel discussion on tooling techniques. It was led by moderators Leonard Mingus and Gerald Curtin of William P. Stein Co. and Eastman Kodak Co., respectively.

Panel members were: Sigurd Michaelson, Eastman Kodak; R. L. Gergen, Pipe Machinery Co.; Joseph Yahn, Monroe Tool & Die Co.; Wayne Norton, Optical Gaging Products, Inc.; Hans Liebert, Manufacturing Tool & Die Co., Inc.; Karl Fuchs, Alliance Tool and Die Corp.; and John McCafferty, Brace, Mueller, Huntley, Inc.

—Paul A. Bruno

Fairfield County Tours Aircraft Plant

Some 125 members of the Fairfield County ASTE chapter met at the Hitchin Post Inn in Bridgeport, Conn., recently and then toured the Sikorsky Aircraft Division of United Aircraft Corp. in Bridgeport.

Special guests at the meeting were Richard A. Smith, a national director of ASTE; and Emanuel Lull, area captain of the National Membership Committee. Mr. Lull as coffee speaker, spoke briefly on the need for new members. *—Henry E. Busby*

ROCHESTER PRESENTATION—Robert Conway, right, receives the 1954 scholarship award from William Kamola, left, first vice chairman. Looking on is Jerald Sick, chairman of the chapter.

Welding Tools and Dies Discussed at Montreal

Members and guests of the Montreal chapter, numbering 125, met on November 17 to hear a talk on "New Developments in the Welding of Tools and Dies." The speaker was L. D. Richardson, chief sales engineer for Eutectic Welding Alloys Corp. of Flushing, N. Y. Mr. Richardson illustrated his talk with motion pictures and slides.

—F. C. Henderson

Elected Board Chairman

J. P. Gill, president of the American parent company of Vanadium-Alloys Steel Co., Latrobe, Pa., who has also been serving as president of Vanadium-Alloys Steel Canada, Ltd., has been elected chairman of the board for the Canadian company. J. Gordon Baker takes Mr. Gill's place as president of the Canadian company. Mr. Gill is a member of the Pittsburgh chapter of ASTE.

W. Fay Aller Talks on Automation Gaging

Presented for an audience of 160 Windsor members and guests, a program on automation gaging was given November 8 by W. Fay Aller, director of research for the Sheffield Corp. The technical session was part of a meeting sponsored at the Prince Edward Hotel by A. C. Wickman Co.

Four new members were welcomed to the chapter and introduced by Ernie Clifton, chairman of the membership committee. They were: W. Nickleson, G. Duncan, R. Poultney and P. Hind.

—A. Underwood, Jr.

Pratt & Whitney Speakers Address San Antonio

The newly organized San Antonio chapter held its first 'post-chartering' meeting on November 10 at the Blue Bonnet Hotel. Speakers were Curt A. Johnston and Donn Dickson of Pratt & Whitney Division, Niles-Bement-Pond Co.

After an introductory talk by Mr. Johnston, a brief history of the firm and background information on its latest precision machine tools were given by Mr. Dickson. A film illustrated the precision methods and equipment utilized by P & W craftsmen in the manufacture of jig boring machines.

—Stanley G. Gower

Milwaukee Plant Tour

A fine crowd of 182 members and guests of the Milwaukee chapter toured the Allen Bradley Co. in Milwaukee on November 11. Buffet luncheon was served, followed by a light but entertaining interlude of movies on sports and wild life. *—Walter Behrend*

TUCSON TOUR—ASTE members and guests visited the facilities of Tucson Newspapers, Inc. as part of the November 9 meeting. The tour was conducted by Bill Milburn, community service editor. Technical problems were discussed by George Chambers, business manager for the organization.

—Joseph W. Vincent

PHILADELPHIA'S SHOW MUST GO ON!—In spite of no lights and other eerie atmospheric effects caused by Hurricane Hazel, Philadelphia chapter went ahead with its scheduled scholarship night on October 15. A total of $1,500 in education awards was presented to students at the University of Pennsylvania, Drexel Institute of Technology and Villanova University. Recipients were, (seated): Gerard F. Moran, Franklin D. Obermeyer and William F. Madill. The awards were presented by: Arthur Diamond (standing), Campbell Pittsinger, and Col. William Darmody. *Tool Engineers Handbooks* were also presented by Chapter Chairman Edmund Hollingsworth.
—*E. H. Wheeler*

Prentiss M. Brown To Present Address at ASTE Annual Banquet in Los Angeles

Prentiss M. Brown, chairman of the board of Detroit Edison Co. during the period when the utility firm became an internationally recognized leader in the development of atomic energy for peacetime uses, will be the speaker for the membership banquet at ASTE's annual meeting in Los Angeles. The event will be held March 17, 1955, at the Cocoanut Grove in the Ambassador Hotel.

Mr. Brown retired as chairman of the Detroit Edison board in July, 1954, after heading the firm for ten years. During that time the firm initiated a 26-company organization working with the Atomic Energy Commission in research on industrial uses of atomic energy. He continues as a member of the utility board and is also a member of the Business Advisory Council of the U. S. Department of Commerce.

For the past four years, he has been chairman of the Mackinac Bridge Authority, the group charged with the planning for the five-mile-long bridge over the Mackinac Straits which separates upper and lower Michigan.

Under his leadership the Authority has completed preliminary studies, engineering checks and the job of financing the structure which will cost close to $100,000,000.

Prentiss M. Brown

Prior to joining Detroit Edison as board chairman in 1944 Mr. Brown served as a United States senator from Michigan, administrator of the Office of Price Administration and as a member of the United States House of Representatives.

H. C. McMillen Attends Muncie Executive Night

Howard C. McMillen, national ASTE second vice president and a national director, was the guest speaker at Muncie's November 9 executive night program. Muncie chapter was host to 29 industrial executives, public utility managers, as well as the mayor of Muncie.

Following dinner, Carl Darger, chapter chairman, presented a thumbnail sketch of the beginning and growth of ASTE, its development on a national basis, and the aims and policy of the Society.

Mr. McMillen, in his capacity of plant manager of Philco Corp., New Bedford plant in Indiana, spoke on "Management Challenges the Tool Engineer." The meeting was held at the Delaware Hotel. —*Darrell Marks*

Cincinnati Chapter Hears Seven-Man Forum

In November 9, Cincinnati chapter members were dinner guests and plant visitors of the Cincinnati Milling Machine Co. where they heard a seven-man forum of staff members discuss coolants and grinding wheels. The forum was headed by Dr. Hans Ernst, director of research at Cincinnati Milling Machine Co.

The plant tour encompassed the company's Grinding Wheel Division, the Cimcool Manufacturing Division, several research laboratories, machining departments, assembly lines and new equipment in the salesrooms. Program Chairman Jack Elfring was responsible for the successful and valuable program. —*Frank Houston*

Twin Cities Chapter Honors Eric Fasth

In recognition of his able leadership as head of the chapter during 1953-54, an award pin for outstanding service was presented to Eric Fasth at the past chairmen's night meeting held November 3 by the Twin Cities chapter. The presentation was made by Kenneth Robey.

All of the men who have served as chapter chairmen were on hand for the meeting and were given special introductions to the assembled members and guests.

The technical talk was on the subject of roll forming and was delivered by Elmer J. Vanderploeg, chief engineer of the Yoder Tool Co., Cleveland, Ohio.

The meeting was held at the Covered Wagon. —*Walter J. Comstock*

WINDSOR STANDARDS COMMITTEE—The standards committee of Windsor chapter will comprise a panel on JIC Hydraulic Standards. They are, from left: G. Kovosi; A. Reddoch; D. L. Swan, chairman; D. Kirkaldy; P. G. Ivanchich; E. Clifton; N. Paddison; D. Nesbit; M. Blaney; and W. H. Maddock, secretary.

Windsor To Hold JIC Hydraulics Standards Program

Joint Industries Conference (JIC) Hydraulic Standards is the subject at a special technical session being put on by the standards committee of the Windsor chapter on January 17. No admission will be charged and ASTE members and friends from the Detroit-Windsor area are cordially invited. The meeting will take place at Chrysler Corporation of Canada Head Office, Chrysler Center, Windsor.

All members of the Windsor standards committee are participating as a panel to lead discussion. There will be no attempt made to suggest amendments to the standard, only to familiarize all those attending with its value in improving industrial equipment.

Each member of the committee concentrated study on a small section of the JIC Hydraulic Standard so that the committee could act as a "walking index" during the discussion.

Everyone attending the discussion will be supplied with a copy of the Standard for easy reference.

Dennis L. Swan, Windsor standards committee chairman, will act as moderator; and Arnold J. Wearner of John S. Barnes Corp. will be on hand to answer questions pertaining to hydraulics. To round out the evening, a film on the fundamentals of hydraulics systems and example circuits will be shown.

—D. L. Swan

Stanley R. Cope Speaks at Tri-Cities Meeting

Members and guests of the Tri-Cities chapter met on November 10 for a program on standardization of die engineering. Technical speaker was Stanley R. Cope, president of the Acme School of Die Design Engineering, South Bend, Ind. His lecture was accompanied by slides and displays for illustrations. The meeting was held at the cafeteria of the Rock Island Arsenal.

—Clifford C. Vogt

Detroit Member Passes State Examination

Prof. Gordon E. Rivers, department chairman at Wayne University, Detroit, Mich., recently became a registered professional engineer. A member of the Detroit ASTE chapter, Prof. Rivers is also associated with the American Society for Engineering Education.

Lee R. Baker Guest at Indianapolis Meeting

It was Indianapolis chapter's annual executives' night at the Sahara Grotto when some 200 members and guests heard Lee R. Baker, director of the Chrysler Institute of Engineering, deliver the main address of the evening.

In his talk, "From Engineering Student to Engineer," Mr. Baker gave a comprehensive picture of the process a person goes through during the conversion period from engineering student graduate to placement with an industrial firm.

When Mr. Baker arrived in Indianapolis by train he was met by a delegation including Joe Enright, chairman; John Husor, second vice-chairman; Roy Erickson, program chairman; Murray Davidson, editorial chairman; Jack Romine, president of the Indianapolis Junior Chamber of Commerce; and Fred Byers of the executive committe of the Indianapolis Chamber of Commerce. The group presented him with the "Key to Indianapolis Industry."

Joe Enright greets Lee Baker

A highlight of the evening program was the presentation of a past director's tie clasp to D. D. "Pop" Hiatt by Howard C. McMillen, second vice-president of ASTE.

On October 7, the chapter heard Ernest Pawley, sales engineer with the Machine Tool Division of Sheffield Corp. His topic was "Ultrasonic Machining of Hard Materials." He employed slides to illustrate his talk.

—Murray Davidson

Opens Engineering Office

Alvin H. Shairman, Worcester ASTE member, has opened his own engineering, tooling and machine design office at 314 Highland Street in Worcester, Mass. He was formerly associated with Commonwealth Plastics Corp. at Leominster as production superintendent of the Defense Division. Previously he was senior methods engineer at Fenwal, Inc.

Discusses Advances Made in Machine Tool Industry

Speaking at a meeting of the Twin States chapter, E. J. Tangerman, executive editor of *American Machinist*, told about the new developments in machining made since the close of the war. Trends cited by him included: cutting of machining time, more accurate forming of blanks, and increasing production of lighter machine tools. Close to 70 members heard the discussion.

At an earlier technical session, a program on "Production Tooling Problems" was presented by Harry Conn, chief engineer of Scully-Jones and Co., Chicago, Ill. "In the solution of any problem," he said, "90% of the work involved is in properly defining the problem." He outlined the steps necessary to successful solutions, and led an interesting discussion period.

Two new appointments to the chapter's list of committee chairmen were announced. They are: David Armstrong of Fellows Gear Shaper Co., professional engineering; and Joseph Arty of Jones & Lamson Machine Co., membership. —*Maurice E. Blais*

Mid-Hudson Chapter Hears Alfred Sparrow

When 85 members and guests of the Mid-Hudson chapter met on November 15, in Poughkeepsie, Alfred R. Sparrow was the featured speaker. Mr. Sparrow, of Brown and Sharpe's Sales Division, discussed "Automatic Screw Machines and Tool Application."

In his talk Mr. Sparrow described the new attachments for machines and explained how they operated. A film was also shown in conjunction with the talk entitled "Automatic Screw Machines."

During the coffee hour, the film "Operation Blue Jay" was shown depicting the construction of a defense base in Northern Greenland. The film was through the courtesy of H. O. Penn Machinery Co. —*Davis Gale*

Engineer Registration Reviewed by Chapter

The effect of state registration on the engineering profession was discussed November 12 at a meeting of the Portland, Me., chapter. Speaker was Bryant L. Hopkins, secretary of the Main State Board of Registration for Professional Engineers. His address was preceded by a business session and dinner at the Graymore Hotel.

In October the chapter enjoyed its fall outing at Z. M. Eaton's cottage at Sebasco, Me. —*Henry C. Hagman*

NORTHERN NEW JERSEY—Checking notes before the November program are, from left: F. W. Blanchette, sponsor; Fay Aller, speaker; and H. Wilson Ryno, chairman.

Dr. Ellis Speaks at London-St. Thomas

The November 18 meeting of the London-St. Thomas chapter, held at the Town and Country in St. Thomas, had as its featured speaker Dr. O. W. Ellis. Dr. Ellis, of the department of engineering and metallurgy at Ontario Research Foundation, presented a general discussion of the work carried on by the foundation. The nominating committee was also named for the coming elections. It will be headed by Al Trueman. —*W. Reid Grice*

Elected Board Chairman

The P. O. McIntire Co. has announced the election of Sam J. Forbes, former president, as chairman of its board of directors. Mr. Forbes is a member of Cleveland ASTE chapter. Charles D. Shannon has been appointed president and Alfred G. Goglin has been named vice president and general manager.

New Jersey Meeting Draws Large Attendance

More than 175 members and guests of the Northern New Jersey chapter turned out for the November program, "Automation in Relation to Machine Control Gaging." The technical address was made by Fay Aller, director of research for Sheffield Corp., Dayton, Ohio.

A demonstration of some of the industry's latest contributions to tool engineering equipment gave members ample opportunity to see: ultrasonic machining, pantograph grinding, crush grinding, thread grinding, and automatic thread chasing, as well as one of the East's most up-to-date gage laboratories for production sampling.

In October, Harry Conn, chief engineer of Scully-Jones and Co., Chicago, spoke to the chapter on "Production Tooling Problems." Seventy members and friends attended the meeting held at the Hotel Robert Treat in Newark. —*Walter R. Wunderlich*

Richard Crossan Speaks at Springfield Meeting

"Engineering the Cost Out of Tools" was the topic of Richard M. Crossan, vice president of Serge A. Birn Co., Louisville, Ky., in a talk before 50 members of the Springfield, Ill., ASTE chapter. He addressed the November 2 meeting held at The Mill.

Introduced by Program Chairman Ross McNutt, Mr. Crossan described the use of M-T-M as a standard system in the establishment of a time value for performing visualized operations and told how it eliminates the need for costly mock-ups or alternate tools. —*Charles Collier*

SPRINGFIELD SESSION—At a joint meeting of ASM and ASTE members, Prof. Carl F. Floe, third from left, of the Massachusetts Institute of Technology, discussed the subject of selection of steels. Among the 130 persons who attended the program, from left, were: Hollis Moore, Robert Marquis, (Prof. Floe) and Karl Kuralt of ASTE; and H. P. Longston, Donald Barber, Ridgeway Cook, and Brewster Howard of ASM. E. L. Wood was technical chairman.—*George H. Foy*

SOUTHEASTERN MASSACHUSETTS SPEAKER—Addressing the November meeting is Carroll L. Wilson, standing, who spoke on the industrial development of atomic energy and its importance to New England. Shown at the left are: John Cieplik, chapter secretary; Edward Boudreau, treasurer; and Raymond E. Holbrook, first vice chairman.

Discusses Atomic Energy for Industrial Use

In a talk made at a recent meeting of the Southeastern Massachusetts ASTE chapter, Carroll L. Wilson, former general manager of the Atomic Energy Commission, discussed the development of atomic energy for industrial purposes and told about its special significance for New England.

Mr. Wilson spoke to 225 members and guests at a dinner session held at the Hotel Bryant in Brockton. He is vice president and general manager of Metals & Controls Corp.

"In the development of the technology and the building of reactors," he declared, "there will be keen, fast-moving competition. Hence, New England firms must gear their pace to the proper tempo in what will be a fast race."

He listed New England's special assets, as compared to the rest of the nation, which should permit it to play an important role in the development of atomic energy. —*Karl W. Nittel*

DoAll Program Presented for Detroit Members

On November 11, the Detroit chapter was presented "Civilization Through Tools" through the courtesy of the DoAll Co. and the Wilkie Foundation, creator of the exhibit.

Officiating at the program was C. G. Schelly, managing director of the Wilkie Foundation who opened the exhibit with a brief lecture. Jack White, WJR air reporter and commentator, was the guest coffee speaker.

A carbide panel discussed carbide cold heading dies for the Detroit Carbide Section on November 4. Panel members were Arthur J. Stroh, superintendent of cold heading and manufacturing parts at Ford Motor Co.; Herbert Burkman, president of Champion Tool & Die Co., McKeesport, Pa.; and Clyde Rickert of Aviation Tool and Die Co. of Detroit.—*Walter R. Schober*

H. V. Harding Speaks at Battle Creek Meeting

H. V. Harding, assistant to the vice president of Elox Corp. in Clawson, Mich., was the guest speaker at Battle Creek Area chapter's November 8 meeting. The meeting was held at the American Legion Hall and more than 90 members were on hand.

In his talk, "Machining by Electrical Bombardment," Mr. Harding discussed the new machining process by which any known electrically conductive hard metal may be cut without the aid of abrasives or chemicals. He brought out that the yellow brass tool which is used does not even touch the work and, therefore, has no thermal effect on either the tool or the work which would cause warping or burning.

—*Arthur F. Damon*

Ultrasonic Machining Discussed at Long Island

Some 100 members and guests of the Long Island chapter met at the Garden City Hotel in Garden City, L. I., N. Y., to hear a talk on "Ultrasonic Machining of Hard Materials."

Speaker was George C. Brown, sales engineer for Ultrasonic Machining Division of Sheffield Corp. He presented the historical background, research and development of the process as well as described the applications.

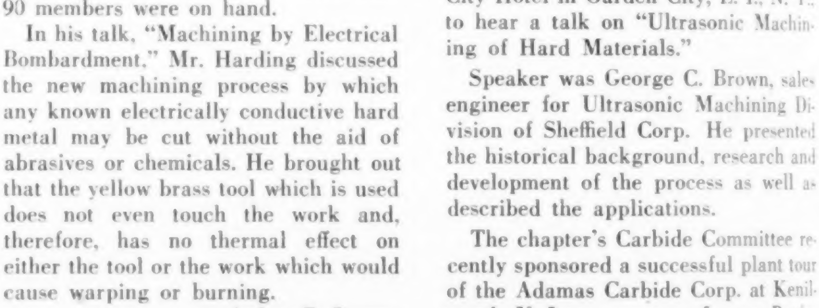
The chapter's Carbide Committee recently sponsored a successful plant tour of the Adamas Carbide Corp. at Kenilworth, N. J. —*Jerome Barfus*

Salt Lake Members Hear John Hussey

"Let's Put the Radial Drill to Work" was the title of a talk made by John Hussey, assistant sales manager for American Tool Works Co., Cincinnati, Ohio, at Salt Lake chapter's October meeting.

The speaker pointed out the use of indexing trunnions and jigs, which allows the combining of operations such as drilling, boring, counterboring, facing, reaming and tapping. Emphasis was placed on the savings that could be effected by taking advantage of the versatility of the radial drill.

—*L. M. Webster*



SEATTLE PLANT TOUR—Pictured at chapter visit to Northwestern Glass Co. are from left: Harold F. Hanson, editorial chairman; A. R. Jones, chapter chairman; and P. O. Perrson, ticket chairman.

LIMA TECHNICAL SESSION—Robert Vidal, center, technical sales representative for Dow Corning, presented the November technical program for Lima chapter. On his right is Gene Siferd, program chairman; and at the left is Chairman R. E. Fromson. The picture was taken by Lyle Udall.

Carl Oxford Becomes Registered Engineer

Carl J. Oxford, Jr., member of the ASTE National Education Committee and research engineer for National Twist Drill & Tool Co., Rochester, Mich., recently passed the state examination for becoming a registered professional engineer. A Detroit ASTE member, Mr. Oxford is affiliated with ASME, ASM, ASTM, IRE, Tau Beta Pi and the Engineering Society of Detroit.

Optical Tooling Subject at Los Alamos Meeting

"Optical Tooling" was the subject under discussion at the November 10 meeting of the Los Alamos chapter. A. W. Young, of Engis Equipment Co. in Chicago, was the guest speaker.

Mr. Young presented a comprehensive program on this phase of tooling in industry, giving a picture of basic principle and applications. Precision measurement is keeping up with the trend of closer and closer tolerances according to Mr. Young. The meeting was held in the Little Theater and 25 attended. *—Basil Boss*

Seattle Members Visit Northwestern Glass Co.

ASTE members of the Seattle chapter toured the facilities of Northwestern Glass Co. at their November meeting. The visitors were welcomed by Gordon Roessler, production manager.

After a talk by company president and manager, E. S. Campbell, guides conducted small groups through the plant and explained various operations, from the raw material stage to the finished product. *—Harold F. Hanson*

K. R. Blake Speaks to Calumet Area Members

Guest speaker at Calumet Area chapter's November 8 meeting was K. R. Blake, president and technical director of Metalloid Corp. of Huntington, Ind. The meeting was held at the Cape Cod Inn, Burnham, Ind., with some 70 members and guests attending.

Mr. Blake discussed the relationship between machinability, tool geometry, velocity, and atmosphere. He touched on the effect of alloys on tool life, depth of energy absorption, when to use positive and negative rake angles, chip thickness, and tool chatter, to mention a few.

—L. W. Montgomery

"Taps and Drills" Is Subject at Lehigh

"Taps and Drills" was the subject discussed by J. Robert Moore and Arthur E. Jamieson at the November 19 meeting of the Lehigh Valley chapter held at Hotel Traylor in Allentown, Pa.

Mr. Moore is chairman of the Northern Massachusetts chapter and chief product engineer at Union Twist Drill Co. in Athol, Mass. Mr. Jamieson is eastern district manager at the same company.

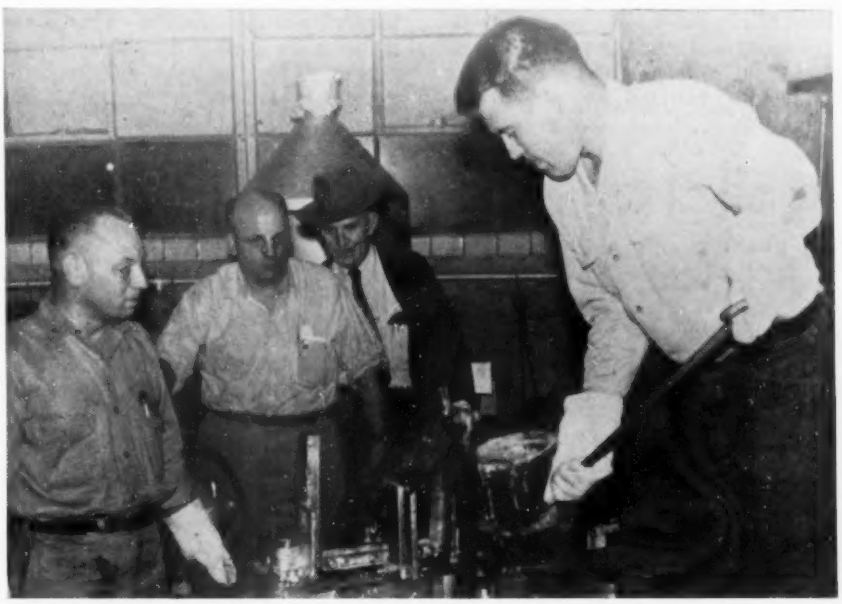
"New Members" was the theme of the dinner meeting. The chapter, which started a membership drive in September, has enlisted 25 new members through the media of posters and letter invitations to the industrial plants within a 50-mile radius. The goal is 200 by March, and with 170 on the roster, the goal seems highly attainable.

The chapter is using the incentive plan. One new member will earn for his sponsor a lapel button, while the sponsor of five new members will earn a tie clasp and cuff link set.

—Paul W. E. Gehris

Twin States Member Passes Vermont Examination

Roger W. Brown, chief engineer at Cone Automatic Machine Co., Inc., Windsor, Vt., recently became a registered professional engineer. He is a member of Twin States ASTE chapter and is also affiliated with AIEE.



UNIVERSITY OF KANSAS MEETING—George Scherer, chief engineer for Cramer Posture Chair Co., Kansas City, Mo., supervises the pouring of a permanent mold casting in the machine that he and his company donated to the university's engineering shop practice department. A registered industrial engineer, Mr. Scherer is education chairman for the Kansas City chapter. His talk was given at the students' November meeting.—*Kenneth Crabtree*

Tool Engineer Magazines Sent to School Libraries

Chautauqua-Warren chapter's education committee has given subscriptions for THE TOOL ENGINEER magazine to three local school libraries. Subscriptions went to Jamestown Community College, Jamestown High School Library and Warren High School Library, according to an announcement by chapter Chairman Herbert Cave.

The regular monthly meeting held November 18 at the Marconi Outing Club in Warren, featured a talk by William Kemper, a metallurgist specialist representing the Carpenter Steel Co. Mr. Kemper discussed the principles of cold hobbing for the benefit of nearly 90 members who attended the meeting.

The nominating committee for coming elections was also named at this meeting. Members are Frank Alexander, chairman; Mel Carlson, and Herbert Cave.

Another feature of the evening program was the film "The Jet Story," presented by E. W. Garrison, program chairman.

—Leslie H. BeauJean and Walter Carson

Bruce R. Artz Addresses Peterboro ASTE Members

Technical speaker at the November 4 meeting, held at the Empress Hotel, was Bruce R. Artz, district manager of the Pangborn Corp. of Syracuse, N. Y. With slides to illustrate his talk, he spoke on the uses and methods of operation of the three basic types of blast equipment. About 40 members attended the program. The speaker was introduced by Ralph Sanderson.

—D. G. Moorby

SERVICE AWARD TO HARTFORD PAST CHAIRMAN—For his forty years of service at Pratt & Whitney, Division of Niles-Bement-Pond Co., C. W. Moeller, left, was presented a special pin by D. H. d'Arcambal, second from right, at a recent ceremony. Mr. Moeller is a past chairman of the Hartford chapter and Mr. d'Arcambal, Pratt & Whitney president, is a past president of ASTE. Witnessing the presentation were: R. W. Banfield, executive vice president, and J. C. Molinar, sales manager.

—A. Douglas Proctor

Binghamton Members Guests of Ozalid

A plant tour of Ozalid, division of General Aniline Corp. at Johnson City, N. J., was on the Binghamton chapter's November agenda. Some 120 members and guests attended.

The group was welcomed to the plant by Robert Richardson, personnel manager of Ozalid, who introduced two company speakers. They were J. Washburn, technical assistant to the general manager, and W. Schink, engineering service supervisor. The men discussed in particular, the making of templates by using the original drawing or layout of part. After the talks, the Binghamton members toured the plant facilities.

—Paul Adamek

BINGHAMTON PLANT TOUR—Officers of the Binghamton chapter discuss operations of the Ozalid plant with two of its representatives. From left are: Wendell Harper, second vice chairman; Andrew Komar, secretary; Phillip Taylor, first vice chairman; J. Washburn, technical assistant to the sales manager, Ozalid; W. Schink, engineering service supervisor, Ozalid; David O. Williams, chapter chairman; Joseph Pokarak, program chairman; and Charles King, treasurer.

"What Is a Silicone?" Topic at Lima Meeting

The November 18 technical meeting of the Lima chapter, held in the Royal Pine Room, featured a talk by Robert Vidal, technical sales representative of Dow Corning, Cleveland. Mr. Vidal showed a colored film on silicones and discussed their uses in aiding production in numerous industries.

New members were introduced by John Rentz. They are K. O. Swisher of Baldwin-Lima-Hamilton and R. E. Olt of Westinghouse.

Guests introduced by Evan Fieghtner were: Larry Borschers, N. F. Steineman, Neil Leininger, Lloyd Buchanan, John Fox, John Burgoon, C. A. Stand, E. S. Kirk, and Nort Spyker. W. M. Vickers of the Muncie chapter was introduced by W. J. James.

Following the technical session a film entitled "Holding Power" was shown by Frank Park, presenting the story of fasteners. The film was through courtesy of Bethlehem Steel.

—Donald Cox

Toronto Hears Engineer from Michigan Tool Co.

More than 150 members of the Toronto chapter met November 3 to hear a discussion on "The Art of Gear Manufacturing." Speaking to the group was Charles R. Staub, chief engineer, Michigan Tool Co., Detroit. His talk was followed by a lively question and answer period. The meeting took place in the Oak Room at Union Station.

—H. N. Holwell

J. Rinek Discusses Trends in Machine Design

Speaking at the November meeting of the Syracuse chapter, John A. Rinek of the Avey Drilling Machine Co., Covington, Ky., told about the new trends in machine design in a talk entitled "Standard Component Special Machinery." About 75 members and guests attended the session held at the Onondaga Hotel. Mr. Rinek pointed out that by using one of his firm's standard machines, plus a package deal, the equipment could be converted into highly productive machinery with as many stations as may be required to produce the work economically. When the need arises, the same machine can be converted back to serve its original purpose. Slides were shown to illustrate some of the applications and the versatility of the equipment.

J. A. Rinek

—*Andrew A. Lachner*

ROCKFORD SPEAKERS—Heard at a recent meeting were Richard E. Arms, left, city-county planning director; and George C. Aitken, director of drafting at General Motors' Chevrolet Division. Chapter member Ed Schenk, right, gave a report on the Illinois Tool Engineering Conference.

Rockford Learns About Corvette Plastic Body

The director of drafting at Chevrolet Division of General Motors Corp., George C. Aitken, told Rockford members about the Corvette plastic body at their October chapter meeting. Colored slides showed step by step details of the construction of the sports car and two models were on hand to give members demonstration rides.

The coffee talk by Richard E. Armes, city-county planning director, covered planning objective and problems encountered recently. —*Les Teachout*

SAN FERNANDO MEETING—Subject for the technical session was "Metlbonding," which was covered by William D. Rainey, far left, technical sales manager for Narmco Resins & Coatings Co., Costa Mesa, Calif. Shown with him at the speakers' table are, from left: H. T. Young, chairman; Keith Griffin, first vice chairman; C. L. Goodspeed, treasurer; and Sam Schwartz, secretary. Eighty members and their guests attended the program held at Hody's Restaurant.

Tracer Controls Topic of Little Rhody Meeting

"Tracer Controls on Lathes and Machine Tools" was the topic of a talk given by Stanley Brandenburg at the November 4 meeting of Little Rhody chapter. Mr. Brandenburg is vice president in charge of sales, Monarch Machine Tool Co. of Sidney, Ohio.

Director Smith

"National family members" present included Ray H. Morris, past president; and Richard A. Smith, a national director.

Coffee speaker was L. R. Clowes of L. R. Clowes, Inc., who presented a film on "The Lathe Master," an accessory toolholder for all types of lathes.

Plans were announced for the forthcoming chapter event on January 6 when winners of the essay contest will be awarded scholarships. Many state and city officials are scheduled to be on hand, including Governor Dennis J. Roberts and Walter Reynolds, mayor of Providence. —*Richard Kilbane*

Albuquerque Holds Optical Tooling Program

At the November 9 meeting of the Albuquerque chapter held at the Desert Inn Motor Hotel, A. W. Young, sales representative for Engis Equipment Co. of Chicago, was the guest speaker.

With "Optical Tooling" as his subject, Mr. Young discussed the application of the "line of sight" or beam of light principle to accurately inspect jigs, fixtures, etc., using adjustable precision telescopes and reflecting targets, and auto-collimators as light sources.

Plans were formulated to hold the Inter-Rocky Mountain chapters' conference in Albuquerque early this year. A host committee was named for the annual event. The nominating committee for 1955 was also appointed. It will consist of Harold Baecker, Jim Felter and John Risley. —*H. E. Anderson*

Charles Hautau Speaker at Elmira ASTE Meeting

When members and guests of the Elmira chapter met at the Mark Twain Hotel in Elmira on November 1, Charles F. Hautau, chief engineer of Hautau Engineering Co. in Detroit, was the guest speaker.

Mr. Hautau, speaking on "Automation," presented the subject both from theoretical and practical viewpoints, illustrating his ideas through films and sketches. Over 100 persons attended the meeting.

A nominating committee was also elected at the meeting to pick a slate of candidates for the coming election. On the committee are Donald Mosher, chairman; Edwin C. Bates and Raymond Banfield. —*Earl E. Marks*

Management Night Held by Louis Joliet Chapter

Louis Joliet chapter's annual management night was held Cantigny Post on November 16. Some 110 members and guests who attended heard a talk by H. Dale Long, assistant secretary-treasurer and a national director of ASTE. Mr. Long, also president of Scully-Jones and Co. of Chicago, gave a brief talk accompanied by slides on where the tool engineer is today and where he can be in 1955, if he keeps up with new developments. He was introduced by Chairman Mel Burdett.

The technical portion of the program featured a talk by H. E. Hawkins who is service engineer for Minneapolis-Honeywell's Micro-Switch Division. He talked on the origin of his company and the specific uses of the Micro-Switch, closing with a 45-minute film on the general uses and manufacturing of the Micro-Switch.

From left: Otto Wesimann, H. E. Hawkins and H. Dale Long.

On November 6 Louis Joliet chapter held its second annual ladies' night which was attended by 102 couples. The women were presented with corsages. Master of ceremonies was Don Domnick and entertainment was provided by Gladys Bowers, wife of the first vice chairman, who presented a program of marimba solos. Featured musical entertainment was by "The Johnstones." The balance of the evening was devoted to dancing. —*Lionell Rohman*

Appointed Sales Engineer

W. B. McClellan, sales manager of The Gairing Tool Co. announces the appointment of B. E. Logsdon as sales engineer on machine tool applications and special assignment, working from the company's office in Detroit. Mr. Logsdon, a member of the Lima chapter, was formerly chief engineer of Sheldrick Manufacturing Co., Sandusky, Ohio.

PEORIA PROGRAM—Featured speaker at the November meeting was Robert R. Rhodehamel, center, general sales manager for the National Acme Co. Chapter officers shown with him, from left, are: L. H. Johnson, secretary; W. Bahnfleth, treasurer; Mr. Rhodehamel; Sam Williams, technical chairman; and W. Ballard, second vice chairman. The meeting was held at the American Legion Hall.

Worcester Lecture Given by John W. Lengbridge

A discussion on the evaluation of drawing versus spinning highlighted the November meeting of Worcester chapter. Speaker was John W. Lengbridge, proj-engineer at Aluminum Goods, Ltd., of Toronto, Canada. Close to 50 members and guests were on hand for the dinner session held at Putnam & Thurston's Restaurant. —*John C. Lalor*

Plant Visitation on Williamsport Program

A tour of the Pennsylvania Power & Light Co. station at Sunbury, Pa., was made by Williamsport ASTE members at their November meeting. The group was welcomed by T. B. Richards, plant superintendent. The station is one of the largest coal-fired electric generating plants on the east coast.

At the October technical session, the chapter heard a talk on high-efficiency machining. Speaker was Thomas E. Hayes, eastern district manager for Carboloy Department of General Electric Co. —*Philip F. Lynn*

Keene Hears Hartman

When Keene Co-Chapter, Twin States affiliate, met on October 28 for its first meeting of the 1954-55 season, James Hartman of the International Research and Development Co. in Columbus, Ohio, was the guest speaker.

Mr. Hartman talked on "Vibration Analysis," demonstrating how vibration could be isolated and measured by using correct instruments. The meeting was held at the Community House in North Swanzey, N. H.—*Charles E. King*

Nominating Committee Named at Peoria

With cash refunds of one dollar each for all advance reservations as an attendance incentive, more than 200 Peoria members turned out for the chapter's annual meeting to select the nominating committee. Elected to select the slate of new officers were: Bill Logue, Ray Zimmerman and Walter Peters.

At the October technical session, chapter members viewed DoAll Company's famed exhibit "Civilization through Tools." The development of man's tools, covering an estimated span of one million years, was explained by C. G. Schelley, managing director of the Wilkie Foundation. Technical chairman for the program was E. L. Breese.

Speaking at the September program was George L. Boehm, chief sales engineer for S. C. Johnson & Son, Inc., Racine, Wis. —*Harold D. Baker*

"Operation Push Button" Discussed at New Haven

Many different applications of the air cylinder in industry were covered in a talk made at New Haven's November meeting by William C. Richards, Jr., executive assistant to the president of Bellows Co., Akron, Ohio. Entitled "Operation Push Button," his discussion and film program were presented to an audience of nearly 100 members.

Accompanying Mr. Richards were four other company representatives: Harold D. Granger, eastern regional manager; John Campbell, field engineer; Don Guy, Canadian manager; and Chris Shute, field engineer. The technical session followed an informal dinner and business meeting held at the Hotel Garde. J. P. Meehan was technical chairman.

—*Silas W. Becroft*

C. B. DeVlieg Talks at Chicago Meeting

Guest speaker at the Chicago chapter's November 1 meeting held at Keymens Club was C. B. DeVlieg, president of DeVlieg Machine Co. Mr. DeVlieg presented his talk, "New Arts in Precision Boring," before an audience of approximately 125. He discussed the development and use of the Jigmil and Jigmil technique, explaining how production costs were reduced in boring operations with a very minimum of tooling.

Another highlight of Chicago chapter's November calendar was a plant tour of Lindberg Steel Treating Co. in Melrose Park, Ill., on November 19. Nearly 60 members and guests attended. —*R. C. Berliner*

WORCESTER MEETING—Shown at the speakers' table for the November meeting are, seated from left: J. Irving England, program chairman; John W. Lengbridge, speaker; Adam T. Kosciusko, chapter chairman; and John C. Lalor, editorial chairman. Standing: Ralph A. Baker, scholarship chairman; John E. Rotchford, member of the National Standards Committee; George L. Gershman, entertainment chairman; and Paul E. Porter, membership chairman.

EVANSVILLE EXECUTIVE NIGHT—A well-received program is reflected on the faces of these principal participants in the Evansville executive night. From left are: L. B. Bellamy, past president of ASTE, the guest speaker; John Race, chapter chairman; H. C. McMillen, second vice-president who was toastmaster; and H. O. Roberts, mayor of Evansville.

Nashville Members Advised on Tool Steels

A film on the manufacture of stainless steel and a talk on the selection of tool steels comprised the November technical program for the Nashville chapter. Speaker was J. R. Richards, tool steel service engineer for the Crucible Steel Co., Syracuse, N. Y. Sponsored by the Vance Iron & Steel Co. of Chattanooga, the program was presented at the Andrew Jackson Hotel for an audience of 40 ASTE members and guests. *—Harry O. Collins*

Phone Co. Representative Speaks at Portland, Ore.

A talk on electronics and transistors was given for Portland, Ore., members on November 18 by C. E. Seavey of the Pacific Telephone and Telegraph Co. The program was part of a dinner and business meeting held at Burns Restaurant. Among the announcements was the news that chapter membership had almost doubled in the past year. The meeting was conducted by Chairman Fred Mondin.

—Walter Brenneke

Tool and Die Welding Discussed at Erie

"Tool and Die Welding" was the subject of a talk given by L. D. Richardson of Eutectic Welding Alloys Corp. in New York City, at the November 2 meeting of Erie chapter. Mr. Richardson supplemented his talk with slides and the group saw a half-hour movie entitled "Welding America." Thirty-two attended the session at the Sportsmen's Athletic Club.

—Samuel A. Fiorenzo

Executive Night Held at Evansville

When Evansville chapter held its annual executive night program on November 8, Past President Leslie B. Bellamy was the special guest speaker. Another ASTE officer, Howard C. McMillen, second vice-president of ASTE, was toastmaster for the evening program.

Mr. Bellamy, general manager of The Sterling Abrasive Division of Cleveland Quarries Co. in Tiffin, Ohio, spoke on "The Engineer's Role in Modern Industries." He pointed out the need to find jobs for the men whose roles in industry will eventually be eliminated by "automation."

The guest list included many civic and industrial leaders and dignitaries from the area. The meeting was held at Smitty's Steak and Seafood House and attendance was recorded at 116.

—Guenther F. Wulf

Pennsylvania Chapter Hears Frank D. Clark

Frank D. Clark, company secretary and director of Van Keuren Co. of Boston, was guest speaker at the Central Pennsylvania chapter's November meeting. Held at the West York Inn in York, Pa., 50 members were present for the meeting and heard Mr. Clark's talk on "Measurements in Millionths with the Use of Optical Flats."

The chapter selected its nominating committee for the coming elections which consists of Burnell C. Stambaugh, chairman, James Rodgers and Ralph Schnieder.

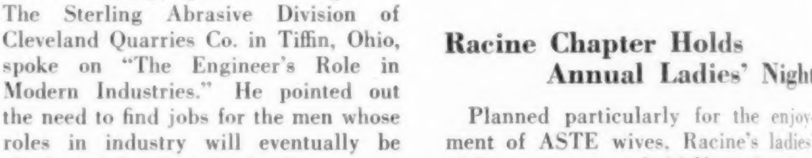
Dave Schrom and his committee announced that the plans to entertain the boys of the Pennsylvania Soldiers Orphans School of Scotland, Pa., next April were all but completed. The chapter will be host to approximately 40 boys and five instructors for plant visitations in York, dinner and vocational counseling.

Another business report, given by Raymond Meckley, revealed that he and his committee had been successful in steps to form an engineering council for York. The group will be designated as Technical Societies Council and will include eight such societies in the area. *—Paul F. Leese*

Racine Chapter Holds Annual Ladies' Night

Planned particularly for the enjoyment of ASTE wives, Racine's ladies' night program was held November 1 at Dania Hall. An attendance of close to 125 persons was recorded for the annual event. After dinner was served, the group heard a talk on lost treasures by Ken Krippene.

—Alvin J. Michna



ERIE OFFICERS AND GUEST—Snapped after Erie's November technical session are Lyman Austin, program chairman; William Snook, chapter chairman; L. D. Richardson, guest speaker; and William Sedler, chapter secretary.

W[illegible] Lubricants Topic at [illegible]s Moines Meeting

"[illegible]x Lubricants in Metalworking" was [illegible] subject of a program presented by [illegible]. King to the Des Moines chapter [illegible]bers and their wives on October 25 [illegible] Hotel Kirkwood. Mr. King is dist[illegible] manager of S. C. Johnson and Son, [illegible], Racine, Wis.

S[illegible] it was ladies night, after a buff[illegible] supper entertainment on the light[illegible] side was also presented. Mrs. Sexton, wife of one of the members play[illegible] several selections on her violin.

—*J. J. Schlesselman*

Hamilton Chapter Tours Motor Plant

On November 12, some 129 members of the Hamilton District chapter left Hamilton Bus Terminal aboard four buses, bound for St. Catharines. The group stopped for dinner at Prudhommes Garden Centre Hotel on the Lizabeth Way and proceeded to McKinnor Industries new motor plant. At this plant are manufactured V-8 engines for 1955 Chevrolets, Pontiacs, and Oldsmobiles.

The party was split up into small groups and each was allotted a guide. The machining and processing of the engine component parts were followed through and explained, particular interest being taken in the automobile machining of cylinder blocks. The group also visited the engine assembly line, final testing and dispatching to General Motors plants at Oshawa.

—*G. W. Hawkes*

Sales Engineers Talk at Greater Lancaster

The Arcadia Cafe was the scene of Greater Lancaster chapter's November 9 meeting when the program included talks by two sales engineers. The speakers were John E. Laffney and William Clark of Federal Products Corp. in Philadelphia. "Gaging for Profit" was the subject of their program. A highlight of the program was a film on gaging before World War II and today. All types of gages were on display for the members to inspect.

At a brief business session before dinner, Raymond Moorhead, Willis Houck and Norman Ressler were elected to serve on the nominating committee for the coming elections.

Guests at the meeting included William Ditt and Robert Raunbach from Belleville, Pa.; and Robert Hoover and Richard Dengler of Lancaster who are associated with the New Holland Machine Co.

—*George Gallagher*

BOSTON SCHOLARSHIP WINNERS—Boston chapter's fourth annual presentation of scholarships was a feature of its executive night program. Congratulations went to the three winners from Joseph P. Crosby, national ASTE president; Karl G. Nowak, chairman of the Boston chapter; and Robert E. Dean, chairman of the education committee. From left are: Chairman Nowak, President Crosby; Lester Levenbaum, winner from Northeastern University; Carl R. Erickson, winner from Wentworth Institute; Robert A. Kirk, winner from Northeastern University; and Mr. Dean.

DoAll Program Given for Dayton ASTE Chapter

"Civilization through Tools," a program sponsored by the DoAll Co. of Des Plaines, Ill., was presented before a joint meeting of four Dayton technical societies including ASTE, ASQC, ASME, ASM and DSPE. Over 130 members and guests were in attendance.

The program, which featured an exhibit of ten related display panels, dramatically portrayed the panorama of man's evolution in use of tools. It was presented by C. G. Schelly, managing director of the Wilkie Foundation, responsible for the preparation of the exhibit.

DAYTON PROGRAM — Raymond C. W. Peterson, national ASTE treasurer; R. J. Dusseau, chairman; and C. G. Shelly, managing director of the Wilkie Foundation discuss the meeting.

Special guests were Raymond C. W. Peterson, national treasurer of ASTE, and Richard Sullivan, chairman of the Toledo chapter.

—*W. J. Killinger*

Boston Chapter Holds Annual Executive Night

The Morse Auditorium, Museum of Science, was the scene November 10 of Boston chapter's annual executives night. Nearly 50 members and guests attended the event which was also the fourth annual presentation of the chapter's scholarships. One went to a student at Wentworth Institute, and two students at Northeastern University were recipients.

ASTE President Joseph P. Crosby was the coffee speaker and gave a brief resume of growth and present status of the Society. Approximately 40 executives were present from the Boston area.

Guest speaker on the evening program was Carl Reinhold Hellstrom, president of Smith & Wesson, Inc., Springfield, Mass. He talked about the new Smith & Wesson plant and about a 9-mm carbine his company developed for the army.

—*Evo P. Castelli*

Hydroform, Hydrospin Subjects of Program

The Hydroform and Hydrospin were the subject matter of Grand River Valley chapter's November meeting at Shep's Hall in Galt. About 85 members and guests gave rapt attention to George L. Beatty of Cincinnati Milling Machine Co. as he explained the simplicity and wide application of the process. The meeting was adjourned by Chairman Percy Barber and the group enjoyed a buffet luncheon.

—*W. C. Little*

coming ASTE meetings

ALBUQUERQUE—Jan. 11, 7 p.m., Desert Sands Motel, "Forging at Close Tolerances" by Paul Anderson of Arcturus Mfg. Co.

BATTLE CREEK—Jan. 10, 6:30 p.m., American Legion Clubhouse. "Cold Extrusion of Steel" by Hubert J. Pessl, director of shell engineering and research, Gibson Refrigerator Co.

BOSTON—Jan. 13, 6 p.m., Morse Auditorium at Museum of Science. "Modern Machine Techniques" by Malcolm F. Judkins, manager of New Products Division of Firth Sterling, Inc.

CEDAR RAPIDS—Jan. 13. "Dynatomics" by K. R. Blake, president of Metalloid Corp.

CHATAUQUA-WARREN—Jan. 20, at Warren. "Latest Developments in Carbide Tooling."

CLEVELAND—Jan. 14. "Automation" by Pat Masi, Ford Motor Co.

ERIE—Jan. 4, 6:30 p.m., GE Community Center. "Die Casting" by Robert Parker of Parker White Metal Co.

FOX RIVER VALLEY—Jan. 25. A lecture on deep drawing by Stanley Cope, Acme School of Die Design.

GOLDEN GATE—Jan. 19, program on taps and tapping.

GRANITE STATE—Jan. 18, 7 p.m., New City Hotel, Rochester, N. H. "Surface Finish—the New ASA Standard—What They Mean to You" by L. Thorpe Thompson, Brush Electronics Co.

GREATER LANCASTER—Jan. 11, 6:45 Arcadia Cafe. Program on precision boring by a representative of Heald Machine Co.

HAMILTON DISTRICT—Jan. 14, Brant Hotel, Brantford. "Electronics at Work" by E. L. Palin, Ryerson Institute of Technology.

HARTFORD—Jan. 3. "Surface Finish—the New ASA Standard—What They Mean to You" by a representative of Brush Electronics Co.

HENDRICK HUDSON—Jan. 19. "Industrial Waxes" by a representative of S. C. Johnson & Son, Inc.

INDIANAPOLIS—Jan. 6. "Basic Considerations in Aluminum Forming" by E. V. Sharpnack, Sr., chief forming engineer, Reynolds Metals Co.

LEHIGH VALLEY—Jan. 21, 8 p.m., Hotel Traylor, Allentown. "Coated Abrasives" by a representative of Behr-Manning Corp.

LIMA—Jan. 20, 6:30 p.m., Royal Pine Room. "Hydraulics as Applied to Industrial Machinery" by E. O. Clark of Vickers, Inc.

LITTLE RHODY—Jan. 6, 6 p.m., Johnsons Hummocks. Award night with Governor Dennis J. Roberts as a special guest.

LONG ISLAND—Jan. 10, 8:30 p.m., Garden City Hotel. "The Air Force Heavy Press Program" by Bernard Anscher of Hydropress, Inc.

LONDON-ST. THOMAS—Jan. 20, program on hack saws and how to use them.

LOUIS JOLIET—Jan. 18, 6:30, p.m., Woodruff Hotel. "Induction Heating" by H. B. Osbohn, Jr., technical director, The Ohio Crankshaft Co., and first vice president of ASTE.

NASHVILLE—Jan. 18, 8 p.m., B & W Cafeteria. Talk by Marion Lloyd of Southern Bell Telephone Co.

NEW HAVEN—Jan. 13, plant tour and dinner at Crucible Steel Co. Talk on machining and working of titanium.

NORTHERN MASSACHUSETTS—Jan. 18, 7 p.m. dinner, 8 p.m. program. "Oil Hydraulics on the Production Line" by Francis R. Springer, sales engineer, Denison Engineering Co.

NORTHERN NEW JERSEY—Jan. 11, 8 p.m., Hotel Robert Treat. "What the College Can Do for the ASTE" by Prof. G. B. Thom, chairman of the mechanical engineering dept., Newark College of Engineering.

PHILADELPHIA—Jan. 20. "Welding for Tool Salvage" by L. D. Richardson of Eutectic Welding Corp.

PORTLAND, ORE.—Jan. 20. Program presented by representative of Greenfield Tap and Drill Co.

SAGINAW VALLEY—Jan. 2[illegible] 7 p.m., Hotel Zehnder, Frankenmuth, "Patent Law and Tooling" by [illegible] R. Alden, research and patent engineer, Ex-Cell-O Corp.

SAN FERNANDO VALLEY—Jan. 5, 7 p.m., Hody's Restaurant. Panel discussion on carbide cutting tools.

SANTA CLARA VALLEY—Jan. [illegible]8. "Friction Sawing, Past and Present" by J. M. Lewis, author of section on the subject in the *Tool Engineers Handbook*.

SCHENECTADY—Jan. 10, 8 p.m., American Legion Post *21 Home. "Tool & Die Salvage Welding" by Herman Greif, divisional sales manager, Eutectic Welding Alloys Corp.

SEATTLE—Jan. 25. "Metal Forming in Aircraft" by Ed Hangen.

SOUTHEASTERN MASSACHUSETTS—Jan. 18, program by E. Y. Hellyar, assistant sales manager of Monsanto Chemical Co.

SOUTH BEND—Jan. 15, grand ballroom of Oliver Hotel. Ladies night.

SPRINGFIELD, ILL.—Jan. 4. "Automation Applied to Machining of Die Cast Aluminum Parts" by Frank Zagar of Zagar Tool Co.

SPRINGFIELD, MASS.—Jan. 10, 7:30 p.m., Springfield Turn-Verein. "Ultrasonic Machining of Hard Materials" by George C. Brown, sales engineer, Sheffield Corp.

TRI-CITIES—Jan. 12, 6:30 p.m., Rock Island Arsenal. Program on gears presented by a representative of the Illinois Tool Works.

TWIN CITIES—Jan. 5, Covered Wagon. "Transfer Machines" by J. H. Mansfield, Greenlee Bros. & Co.

TWIN STATES—Jan. 12. "Automatic Factory" by David Smith of Jones & Lamson Machine Co.

WESTERN MICHIGAN—Jan. 10, 7 p.m., Varsity Grill. "Trends in Modern Forging" by H. T. Cousins, district manager for National Machinery Co.

WINDSOR—Jan. 10, 6:45 p.m., Elmwood Casino. Program on milling by a representative of Sundstrand Machine Tool Co.

LONG BEACH DINNER DANCE—It was the fifth annual dinner dance for Long Beach members and their wives. The social doings took place at the Lakewood Country Club and the ladies carried home many prizes to make the evening a memorable occasion. —*C. W. Ward*

March 14 thru 18, 1955

Coming—in March! The first ASTE WESTERN industrial exposition

Los Angeles Shrine Auditorium and Exposition Hall

With...

...HUNDREDS OF EXHIBITS of Tools • Machines • Supplies Processes • Equipment to cut costs and increase your production . . . exhibits tailored to the needs of Western Industry.

. . . and THOUSANDS OF KEY PRODUCTION EXECUTIVES, Tool Engineers and other buyers attending who *need* these exhibited products for their own plant expansion and increased production.

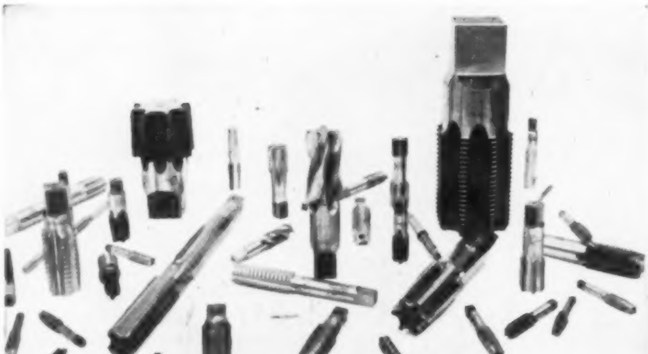
THE WEST'S BIGGEST INDUSTRIAL EXPOSITION . . . over 80,000 square feet of exhibits . . . running concurrently with the

MOST VITAL ALL-INDUSTRY PRODUCTION CONFERENCES the West has ever known . . . *held on the site of the show* with the cooperation of other technical societies and trade associations.

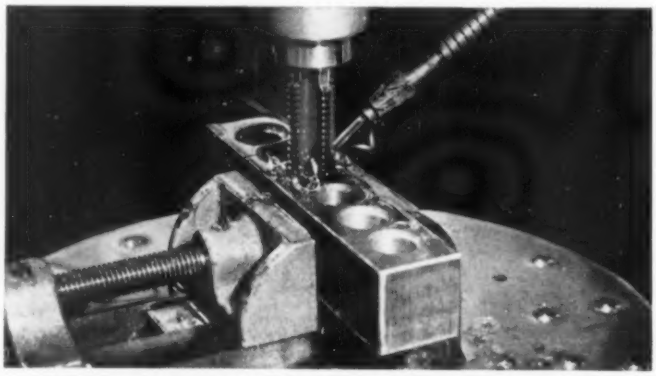
For complete information contact ASTE National Headquarters immediately.

AMERICAN SOCIETY OF TOOL ENGINEERS
10700 Puritan Ave. • Detroit 38, Michigan

HY-PRO SPECIALIZES IN TAP USES



NO MATTER WHAT YOUR TAPPING NEED MAY BE, Hy-Pro has available a selection of thousands of taps which include all categories.



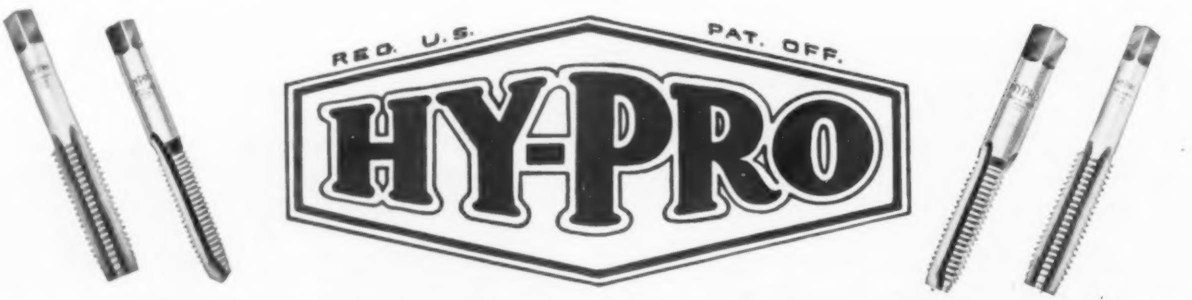
ANALYSIS AND RECOMMENDATIONS by Hy-Pro's specialists have saved time and cut costs repeatedly for Hy-Pro's customers.

...to help cut time from your schedule

Hy-Pro concentrates its operation on the production of taps. Every effort is made toward the improvement of tap efficiency and cutting tapping costs.

Time and time again, manufacturers have saved man-hours in their operations through the help of Hy-Pro's tap experts. This repeated success has gained them recognition in business as "*The Tap Specialists*".

It will pay you to contact your local Hy-Pro distributor today or to call the company direct. Hy-Pro offers you the exclusive benefit of specialized tap production in its complete line of high-quality taps.



HY-PRO TOOL CO., NEW BEDFORD, MASS., U. S. A.

DISTRIBUTORS IN ALL LEADING CITIES

ADDITIONAL WAREHOUSES: 6046 COLLEGE AVE. OAKLAND 18, CALIF. PIEDMONT 5-4337 — 10428 W. McNICHOLS RD. DETROIT 21, MICH. UNIVERSITY 4-1077 — 1132 LAWLER ST. (WORTH) CHICAGO, ILL. GARDEN 4-0217 — 109 EDISON PL. NEWARK 5, N. J. MARKET 2-4318

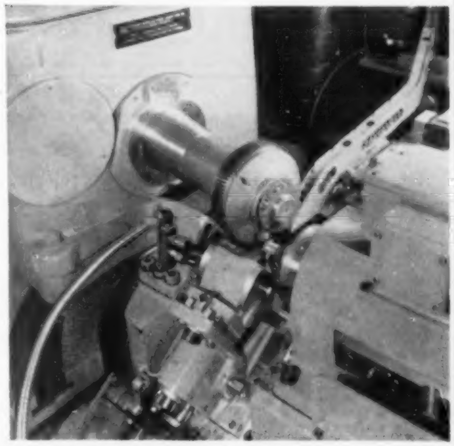
PROGRESS in production

SIMULTANEOUS CHAMFERING AND SHAVING

Development of a process that permits accurately controlled chamfering of the tips of the teeth of automotive pinions at the same time the teeth are being shaved has been accomplished by engineers at The Fellows Gear Shaper Co.

Basic unit is a "Full-tool" gear shaving machine tooled for fully automatic operation. It utilizes a shaving tool and a rotary serrated-tooth chamfering tool which is located on a movable slide below and at the left of the shaving tool. An air cylinder automatically advances and withdraws the chamfering tool slide in timed relation with the shaving cycle.

As is illustrated in the photograph, pinions roll down a chute from an automatic feeding and drop singly into a carrier, which is the means of moving the pinion to the work arbor. Subsequently the work arbor is moved forward through the hole in the pinion, locates and clamps it for machining.



The shaving tool is automatically set in motion, and when that sequence is completed, the chamfering tool slide is advanced to operate. The chamfering tool is wider than the pinion and is not traversed.

After the first pass of the shaving tool across the pinion, the chamfering tool is withdrawn from the work and the direction of shaving tool rotation reversed for the second pass across the pinion. As soon as the second pass is completed, the pinion is freed and ejected, and another pinion is loaded and the sequence of operations repeated.

AUTOMATED BROACHING

Production facilities concerned with turning out automobiles have been broadened to incorporate an interesting combination of automation and broaching. This automated broaching setup, developed by Colonial Broach Co., broaches splines in two different models of a differential side gear at a total rate for both gears of 800 per hour.

A continuous chain loading conveyor, carrying 144 workholding fixtures, feeds the gears four abreast to side-by-side broaching stations. The unit doing the work was adapted from a standard broaching unit. Its complete cycle consists of indexing the four gears into position, broaching the splines, indexing the fixtures for broach return, and returning the four broaches through the gaps between workholding fixtures. Only 18 seconds elapse during the complete operation.

As the conveyor indexes past the broaching station, the broached parts are carried over the top of the conveyor travel where they start on the downward path. The gears here drop from the fixtures through two separate chutes in each side of the machine.

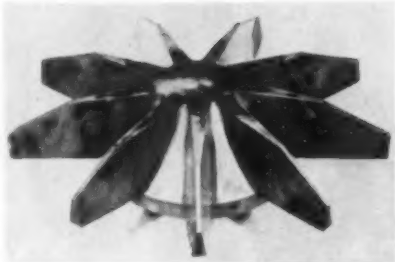
Among the interesting features of the operation, is the fact that two gears are being broached at the same time. They have different hub depths, diameters and spline sizes. One requires a 16-tooth involute spline with a pitch diameter of 1.1562 in. while the second requires a 10-tooth involute spline with a pitch diameter of 1.125 in. Production is maintained separately by using the two right-hand conveyor rows for one gear model and the left hand rows for the other.

SAMPLES SHOW UTILITY OF CEMENTED CARBIDES

New materials in industry often are passed by in favor of more commonly known substances since early applications of materials are limited and their potential values are not recognized. Cemented tungsten and titanium carbides have been in this classification. However, interesting industrial applications of them have been developed that indicate their use will offer unusual pos-

sibilities in the future of machines and industrial processes. Engineers of Kennametal Inc. have been involved in study and experiment concerned with revealing the potential value of the company's own cemented carbide products, Kennametal and Kentanium.

To emphasize the strength, durability and other advantageous qualities of Kentanium, a titanium carbide, the company has displayed an impeller (illustrated) and stationary vane ring used in the first-known 100-hour gas turbine operated at 30,000 rpm at temperature of 1850-1900 F. The specially designed turbine was subjected to the same conditions of temperature and stress that would be encountered in a modern jet engine operating at full power. Little change in the critical parts of the turbine, particularly in the Kentanium impeller, was found. These successful results imply important points for the future of gas turbine power plants—engineers envision a time when further development of these materials, made by powder metallurgy techniques, will enable such turbines to operate at temperatures greater than 2000 F. In that event, fuel efficiency of the turbines could be improved 50 to 100 per cent as a contingent advantage.



Further advantages of the titanium carbide demonstrated by Kennametal are the protective rings that increase scarfing-tip life 30 to 40 times. The same material has also been applied with successful results to tools for flash removal, hot-spinning and hot steel cut-off, with the steel at temperatures as high as 1800 F. An example of its efficiency is in the case of a tube fabricator whose problem was spinning the ends of red-hot steel tubing at 600 rpm. Carbide previously used oxidized and cracked in something less than four hours of service. The titanium material withstood the continuous heat and highly oxidizing condition, lasting about 30 times as long.

Introduction of "throw-away" inserts in the Kennametal line has proved an economical advantage to the user of tungsten carbide tooling.

Another grade of tungsten carbide, a platinum binder carbide, has been demonstrated to offer special wear advantages under particularly corrosive conditions. Engineers have applied it with good results to mating rings used to seal extremely corrosive liquids such as fuming nitric acid.

Advantages of unusual hardness, strength, rigidity and wear-resistance are making the sintered tungsten carbide useful in many applications other than metal-cutting. Engineers are finding it a valuable material for blanking, swaging, heading and forming dies, grinder work rests, gage elements, solid rolls for thin metals and many other uses. The metal, they learn, offers long wear life plus excellent shock and impact resistance.

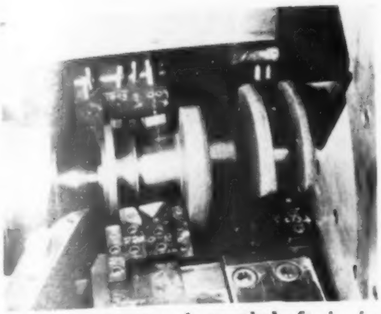
CAST STEEL MACHINING DOUBLES OUTPUT

Cast steel crankshafts were successfully machined, ostensibly for the first time in the automotive industry, with the use of the result that output has been more than doubled as compared to previous production methods.

Work was done on Wickes center-drive lathes with Wesson band-type multicut holders and Wessonmetal carbide.

Machining of the cast steel crankshafts parallels the company's development of carbide tooling applied to this industry's first nodular (cast) iron crankshafts some time ago. In the new operation, several major modifications have been incorporated in the cast steel setup.

Where on the nodular iron crank machining operations 34 tools are re-



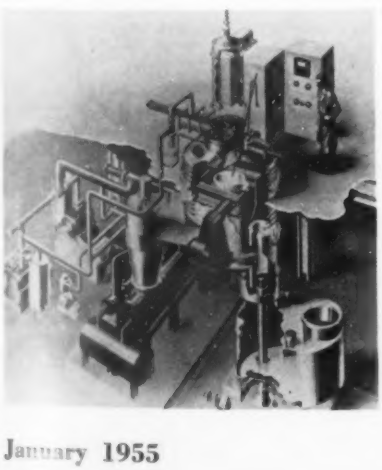
Here the **cast steel crankshaft is in position for machining. Work cycle, which is automatically controlled, operates thus: rapid traverse in, second (or checking) feed, intermediate feed and fine finishing feed.**

quired to turn all five main bearings, flank end and stub end, only 25 special Multicuts mounted on two slides are needed on steel crank tooling. A third slide, consisting of additional Multicuts is designed to cheek the throws when required on the nodular iron setup. Further, on steel setup, dual-insert holders which turn the mains and journal fillets also are designed to perform checking operations when necessary.

The close-precision tolerances with which the cast steel crankshaft manufacturer, Auto Specialties Mfg. Co., Inc., produces the castings, has made it unnecessary to touch the throws.

GIANT VACUUM MELTER

The 1000-lb vacuum-melting furnace that is to be installed at Carboloy Dept. of General Electric Co. pilot plant in Detroit is shown by an artist's drawing of the unit. Control panel for vacuum melting and charging unit are located on the mezzanine floor; melting tank, center, a 3-stage vacuum pump in foreground center, and discharge tank at lower right with ingot mold in pouring position directly above it. The unit, which operates semi-continuously, is being constructed now by the Consolidated Vacuum Corp.

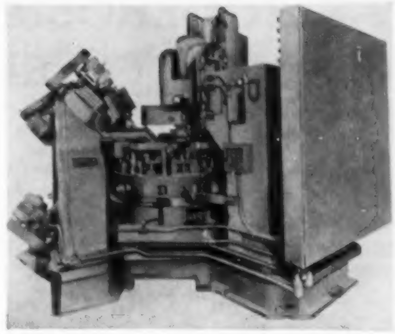


MULTIPLE WORK FROM SINGLE UNIT

Water pump bodies for one of the V-8 engines are drilled, chamfered, spotfaced and taped with a single machine, automatically increasing efficiency, cutting costs and saving time. The unit which accomplishes this work is the Angle-Matic, one of the latest tools released by Michigan Drill Head Co.

In operation, the tool performs operations on both top and bottom of the pump body, drilling all the angular holes needed, by means of a two-position hydraulically operated fixture and angular mounted units.

A standard Hydro-20 column assembly is the basis around which the Angle-Matic is built, while a special base and special risers are incorporated for the horizontal and angular units. Another

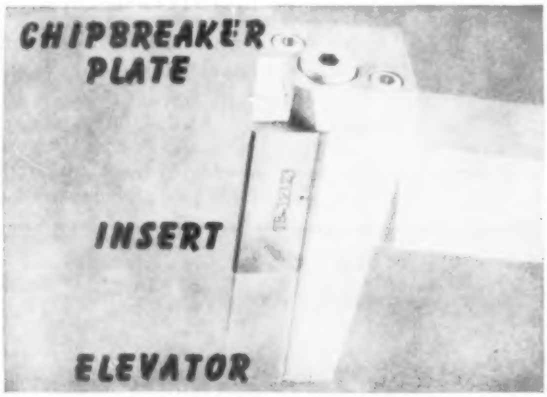


standard, a Michigan 60-in. hydraulic index table, rotates the fixture. Tapping is performed by standard tapping units with individual lead screws.

With this unit and its improvement it has been possible to mark up production rates of 120 pump bodies per hour.

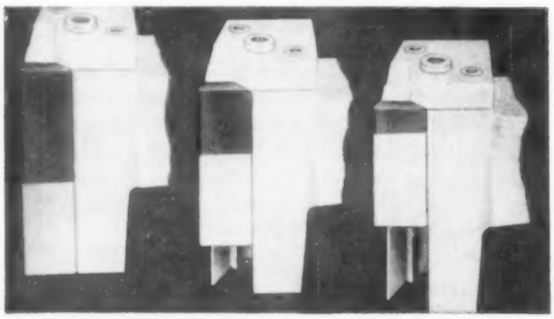
V-R TOOLHOLDERS USE ALL THE CARBIDE... ELIMINATE CHIPBREAKER GRINDING

Old style toolholders require at least half of the carbide for holding purposes,—carbide that can't be used for machining operations. Vascoloy-Ramet has developed a toolholder that uses more than 90% of the carbide insert, eliminating this waste of carbide.



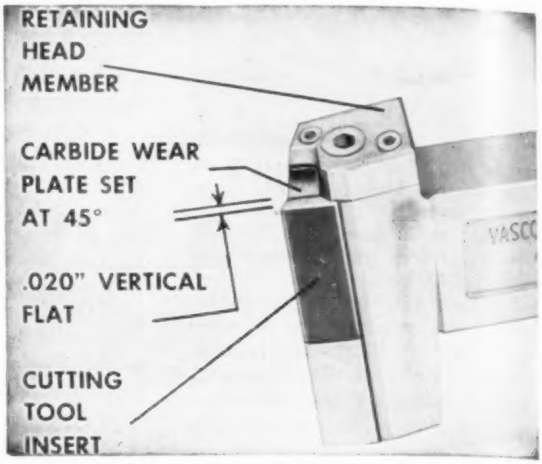
Vascoloy-Ramet Style TBR for triangular insert showing how the insert is held between the chipbreaker plate and the elevator. The elevator is the same size as the insert, giving complete support to the insert.

The New V-R Toolholder works like this: the carbide insert is held firmly in place by pressure between the elevator at the bottom and the chipbreaker plate on the top. Note that the elevator is the same size and shape as the insert, giving complete support to the insert. As the insert wears away and becomes shorter, the bottom movable portion, or elevator, of the toolholder is adjustable upward by turning the main screw in the top of the chipbreaker plate.



As the insert shortens from repeated sharpening, the elevator is moved up by turning the main screw on top of the chipbreaker plate. This method of holding the insert permits using all of the carbide insert.

This one simple adjustment always keeps the cutting edge in precisely the proper position. As the insert gradually shortens from repeated sharpenings, the elevator is moved still farther up in its slot . . . always keeping the cutting edge in the proper position. Instead of using only 50% of each carbide insert, you actually use more than 90% with the V-R Toolholder, leaving only the minimum carbide necessary to support the cutting load properly. Regardless of how many times an insert is sharpened, the cutting edge is automatically in proper alignment with the work. This makes the V-R Toolholder fool-proof, as well as resulting in a saving of over half of the standard 1½" length insert.



The "Built-In" chipbreaker in position on the head of the V-R Toolholder. All that is necessary to start production is to mount the toolholder.

Another feature of the V-R Toolholder is the "Built-In" chipbreaker. This "Built-In" chipbreaker, an integral part of the toolholder, eliminates the need for expensive, ground-in chipbreakers. The chipbreaker plate is an assembly of the retaining head member, made of steel with a tungsten carbide wear plate to act as a chipbreaker. This carbide wear plate is farther away from the work than the shoulder of a comparable ground-in chipbreaker, thus inducing a gentler curling action, resulting in lower chip pressure and in less tool wear, less heat and horsepower. The V-R mechanical chipbreaker also produces broken or segmented chips over a wide range of feeds and depths of cut, something not possible with a ground-in chipbreaker. Users have found this "Built-In" chipbreaker plate provides better chip control than a ground-in chipbreaker in more than 90% of the cases.

Style TBTR Toolholder for triangular "Throw-Away" inserts. Toolholders in various styles and sizes are available for Triangular, Square and Round; for full length 1½" inserts, new "Half-Length" inserts, and New "Throw-Away" inserts.

The New V-R Toolholders are available for triangular, square and round inserts in three different head lengths. A head length for 1½" inserts, a head length for "Half-Length" inserts (for applications where the underhang of the longer head length is objectionable), and a Toolholder for "Throw-Away" length inserts. Further information on the New V-R Toolholders may be obtained by writing the

VASCOLOY-RAMET CORPORATION
820 Market Street
Waukegan, Ill.

TOOLS of today

Milling Machine

Toolrooms, repair depots, tool and die shops, metalworking companies of all sizes have been offered a milling machine, the Toolmaster, by the Cincinnati Milling Machine Co., that incorporates several design innovations. Foremost is the overarm, mounted in dovetail ways in the turret unit. Its construction permits the operator to swivel and position the overarm for universal coverage of the table with the spindle head. Square gibbed saddle-knee bearing, familiar in larger Cincinnati units, is an important factor in the tool's sturdiness.

The knee has a solid top and an ample recess in front of the column face where chips can fall to the base of the machine.

Departing from the conventional design of a "wrap-around" bearing surface on the dovetail guide, the knee bearing is on the column, hence providing several times more resistance to deflection than the dovetail guide alone.

An antibacklash device is incorporated on the table feed screw.

The Toolmaster units are available in three styles: 1A, manual feed to quill; 1B, power feed to quill; and 1C, heavy-duty head. Their standard ranges are: 16 inches longitudinal, 10 inches across and 17 inches vertical.

A 20-page catalog giving all details on the Toolmaster is available from The Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **T-1-1491**

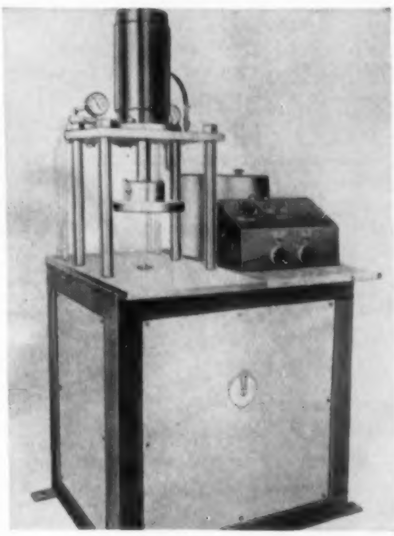
USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Automatic Injection Press

This 3C Industrial Injector Model B, a completely automatic injection press is designed by The Centrifugal Casting Supply Co., 147 West 42nd St., New York, N. Y. for large volume production of accurate wax or plastic patterns for industrial investment casting.

One injection cycle is completed automatically once the operator has positioned the mold over the injection nozzle on the work surface and has flipped the main switch on the control panel. The mold is then clamped, material injected and clamp released in one continuous operation. Injection time can be preset from one second to six minutes. Indicator lights on the control board show each phase of cycle in operation. All phases can be individually operated if desired.

Design features incorporated in the unit guarantee fast, accurate operation at low cost. The die clamping device is automatically motivated by a high pressure air cylinder. The platen pressure pad jointed to the cylinder drive rod, allows up to 15-degree tilt in any direction. Springs in the pressure pad absorb impact and allow air to escape during injection. Its tank holds 75 pounds of injection material at temperatures of 120 to 250 F, while a thermostat maintains temperature with-

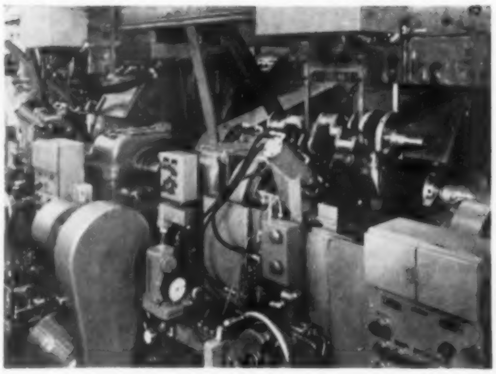


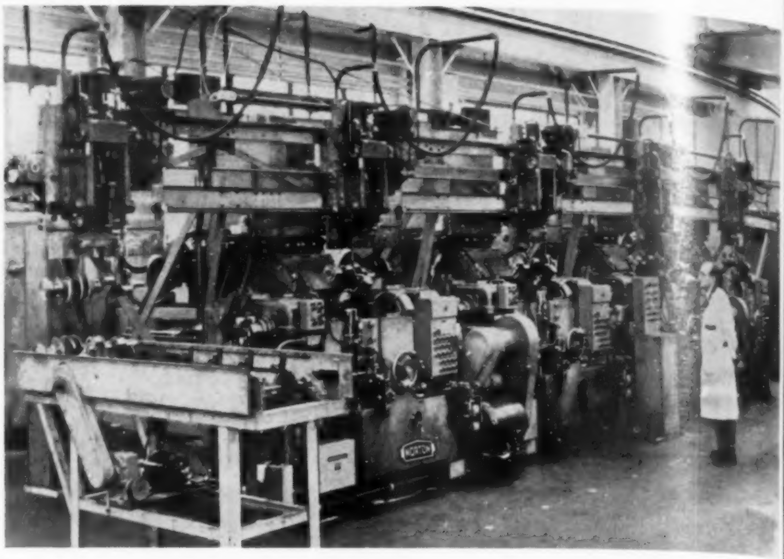
in 2 degrees. Refill of solid material may be made without interrupting production. The hardened steel injection nozzle is heated during operation to maintain temperature of material during injection. Injection pressures up to 1500 pounds per square inch are possible.

Working area of the 3C industrial injector will accommodate molds up to 14 x 8 inches of unlimited length and the entire work surface is ground to eliminate any danger of mold distortion. **T-1-1492**

Grinding Machine

Development of an automatic crankshaft pin grinding machine has been announced by Norton Co., Worcester 6, Mass. This completely automated unit, known as the Transfer Type Crankpin Grinder, is basically a 4-station, 4-wheel machine for V-8 crankshafts. It is so designed that it will pick up a crankshaft from a conveyor line, automatically locate the work in four successive grinding stations where the crankpins are ground to close tolerances, and place the finished work on a conveyor





Above. Closeup view of one of the four grinding stations. The airsnap gage, shown just below the crank which is being lowered, controls size.
Right. Overall view of the automated transfer type crankshaft grinder.

to be carried to the next operation.

Production rate of the grinding machine is from 45 to 60 shafts per hour or roughly one a minute, as opposed to an output of $4\frac{1}{2}$ to 6 an hour on a conventional unit. This speed is at no sacrifice to precision. Work diameters produced, under automatic control, are within a tolerance of plus or minus 0.0002 in.

Floor space required for the unit is 22 x 45 ft, which is less than the area and working room required for conventional grinders of equivalent capacity.

T-1-1501

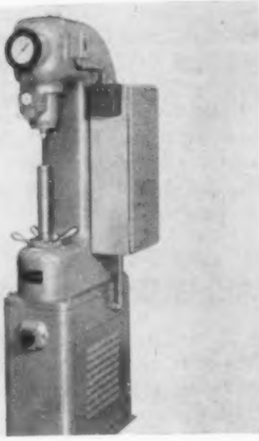
Hardness Tester

Three colored lights, which signal the relative Brinell hardness of the test piece, take the place of operator judgment when testing for acceptability or rejection because of surface hardness with the unit made by Steel City Testing Machines, Inc., 8817 Lyndon Ave., Detroit 38, Mich.

Of particular interest is that the "color glance" Brinnell hardness testing machine may be tied in with some automatic means of handling the parts on a production line basis, and may be used to physically sort the work after testing, thereby making possible automatic Brinell hardness testing.

The three signal lights are set up so that yellow indicates "too hard," green designates "within range" and red shows "too soft." Limits are easily adjustable to suit the requirements of each job. During the test cycle, one of these lights flashes on, indicating the hardness category of the part under test.

The basic unit is an improved earlier model. A dial indicator with adjustable electric contacts has been substituted



for the former standard indicator and this is connected to a specially designed control panel. No electronics are employed. The machine itself is hydraulically operated.

Standard "color-glance" units are available in two sizes. Model KDR-6E has a 6-inch throat depth; Model KDR-10E has a 10-inch throat depth. Both have 14-inch maximum vertical openings.

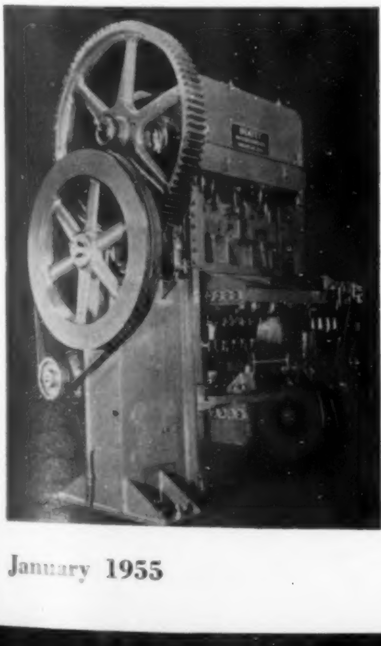
T-1-1511

Web Punch

A guillotine beam web punch with adjustable web punching tools for punching webs of beams, angles, and flat plates has been introduced by the Beatty Machine & Mfg. Co., Hammond, Ind.

The machine, designed primarily for structural steel fabricating shops, has six punching units, each individually controlled, which facilitates setting up to various gage lines. Prime advantages are that it avoids setting-up time and reduces down time.

The maximum setting to outside units



is 33 inches, and the minimum setting between units is $2\frac{3}{8}$ inches.

Punch and die are automatically synchronized.

The tool arrangement is for use with spacing table. The punch is of 200-ton capacity and is built with double housing for added strength and for saving in floor space. T-1-1521

Angle Comparator

A precision angle comparator that has wide applications in machine shop and metalworking departments for comparing parallelism between two surfaces, squareness and angles, is being manufactured by The Perkin-Elmer Corp., Norwalk, Conn. Once the instrument is set up, inspection of finished parts can proceed quickly on a production basis.

Operating entirely on optical principles, the comparator requires no pressure of any kind to be applied to the piece being inspected. Consequently, its precision is independent of operator feel and mechanical gaging.

A brochure, available from the company, gives complete details. T-1-1522

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Two-Way Bending Unit

A horizontal semiautomatic tube bending machine, designed for both clockwise and counterclockwise operations, is announced by Pines Engineering Co., Inc., 601 Walnut St., Aurora, Ill. This unit, the Pine series 1400-A, is designed with an extended main spindle and double ways mounted on the top and bottom of both the stationary and swinging arms. The unitized

head and top assembly is double-hinged to the base which permits turning over the entire assembly 180 degress. This permits bending operations in either direction and interchanging tooling quickly and easily.

Complete tooling change-overs from clockwise to counterclockwise operation can be accomplished in less than ten minutes; with secondary tooling in place, in less than two minutes. Production rate runs about 300 bends (150 pieces) per hour on 1-inch 16-gage steel tubing of 4 feet in length requiring two 90-degree bends.

Capacity of the Series 1400 is 1-inch OD-16-ga. (.062) steel tubing, 1¼-inch OD-16-ga. copper tubing, or ⅝-inch diameter solid steel for stock. Maximum standard radius, with rolling type pressure die is 8½ inches; maximum standard tube length over mandrel is 5 feet; maximum rotation 190 degrees; bending arm speed, variable, is 25 rpm. **T-1-1531**

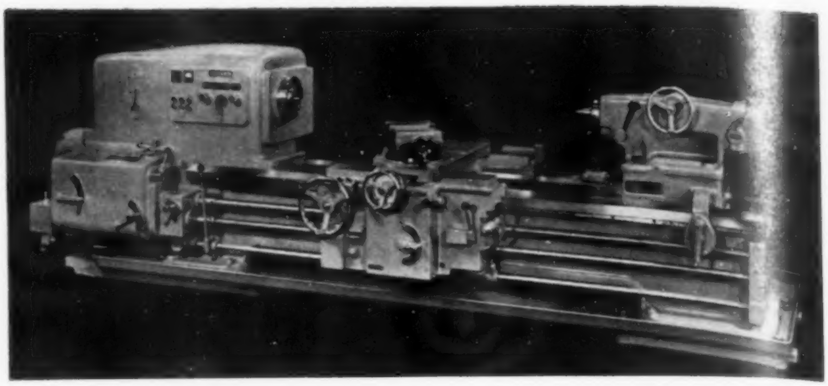
Heavy-Duty Lathe

Carbide tooling may be used to the best advantage on large work with the heavy-duty lathes developed by The Monarch Machine Tool Co., Sidney, Ohio. The machines, the Series 90 Dyna-Shift, are made in three models, each with a main drive motor capacity equivalent to 60 hp. Model 2500 swings 25 in. over the cross slide and has a clearance diameter of 40 in.; Model 2501 swings 31½ in. over the cross slide and has a clearance diameter of 44 in.; Model 2502 swings 36½ in. over the cross slide and has a clearance diameter of 48 in.

Prime feature is the Dyna-Shift headstock which is so designed that an operator can pick the right surface cutting speed for a given diameter and automatically set up the proper combination so that it cannot be changed. The operator merely sets two dials—

one for surface cutting speed desired, and one for the diameter to be turned. Automatically, the headstock gears are shifted hydraulically to give the correct spindle speed at which to operate. Subsequent changes in turning speed on progressive diameters of the workpiece are made similarly.

Although rpm is determined automatically by the fpm and work diameter settings, an indicator on the front of the headstock reflects the spindle rpm for any setting so the information is available if needed.



"Free," "run" and "shift" are the three positions for the Dyna-Shift control lever. Throwing the control in "shift" stops spindle rotation immediately; when the control is in "free" position, the spindle may be rotated easily by slight hand pressure.

Dual levers control work stop and start; their three positions are "run," "brake" and "jog." Both the brake and clutch are hydraulically actuated.

For safety to the operator, the work start-and-stop lever and the Dyna-Shift control lever must be coordinated properly for the operation to proceed.

T-1-1541

Self-Tapping Set Screws

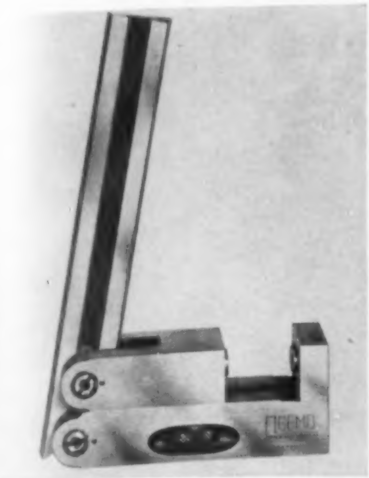
Set Screw & Mfg. Co., has announced its most recent development: Setko self-tapping set screws, available in a full range of sizes down to as small as #2 x 3/32. In addition to being self-tapping, these new set screws are self-aligning and self-locking, yet easily removable when desired. The cutting thread extends only around the top or slotted section and offers two cutting edges, which enables it to cut on both sides of the hole; the shavings, instead of accumulating below, are gathered in the slot. Due to its design, the screw tends to "pull itself in." It can be supplied with any type set screw point.

A bulletin presenting full details about the self-tapping set screw may be obtained from Set Screw & Mfg. Co., 159 Main St., Bartlett, Ill. **T-1-1542**

Precision Angle Gage

Cleveland Instrument Co., 735 Carnegie Ave., Cleveland 15, Ohio, announces the Gemo Bevelgauge, for making and checking angular setups to plus-or-minus 1 minute of arc.

Three parts, base, a slide that moves along the base, and an angle bar which is attached to the base and to the slide by pivots, make up the unit. Angular setting of the angle bar is determined by the position of the slide along the base; and the position of the slide is



governed by gage blocks placed between facing anvils on the slide and base. A standard 37-piece set of gage blocks provides for settings from 0 to 180 degrees with respect to the bottom of the base, in increments of 1 minute of arc (0.017 degrees).

Two angle bars are furnished: a 7-inch straight bar for angles from 45 to 135 degrees, and a 4-inch dogleg bar with 45-degree angle, for angles from 0 to 45 degrees and 135 to 180 degrees. The bars are readily interchanged by loosening the pivots, and can be positioned lengthwise as desired.

Illustrated bulletin 543 gives further details, including setup instructions.

T-1-1551

Metalworking Lathe

Rockwell Mfg. Co.'s Delta Power Tool Div. is entering the metalworking lathe field with the introduction of an 11-in. cabinet model variable speed drive lathe with 24-in. capacity center to center and 1-in. collet capacity. Diameter of the hole through the spindle is $1\frac{3}{8}$-in.

Primarily the tool has been designed for tool and die shops and industrial

metal fabricating shops.

Outstanding feature of the lathe is a patented back gear shift lever, which is located within easy reach of the operator at all times. This lever eliminates need for using wrenches, pulling out pins, or opening guards to shift from direct spindle drive to back gear spindle drive, loose or locked spindle.

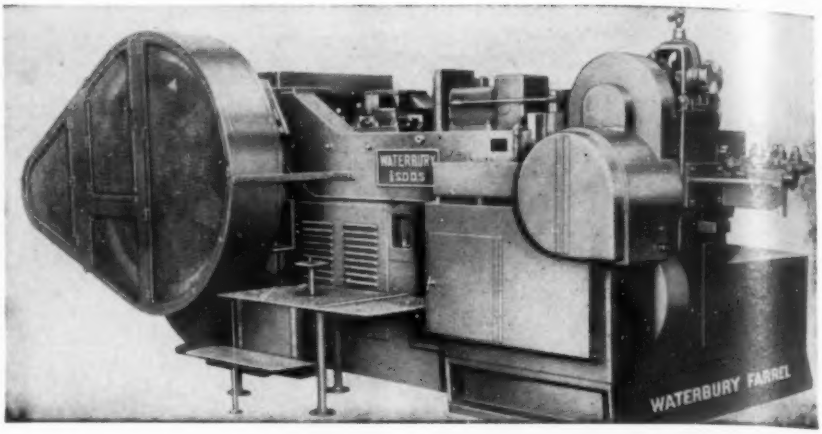
A perfected vari-speed drive offers a speed range of 44 to 1550 rpm with an infinite choice within that range. Speeds can be changed without turning off the machine.

Difficulties formerly associated with vari-speed drives, such as side sway, have been eliminated from this lathe, enabling the drive to run cool and retain its lubricant.

Users are offered a choice between $2\frac{1}{4}$-in.-8 threaded spindle nose and L00 long-taper spindle nose.

A full line of accessories is available, including a durable taper-turning attachment designed for accuracy and easy manipulation, and also micrometer stops, milling attachments and a standard type of collet chuck.

Futher information may be obtained from Delta Power Tool Div., Rockwell Mfg. Co., 438 N. Lexington Ave., Pittsburgh 8, Pa. T-1-1561



Die Header

Cold heading equipment has been introduced by Waterbury Farrel Foundry and Machine Co., Waterbury, Conn., with the development of a $\frac{1}{2}$-inch "Waterbury" solid die double stroke header.

The Waterbury header is built in both long and short stroke, with the crankshaft throw the only difference in construction.

The more versatile is the long stroke machine. Both long and short work can be produced at the rate of 80 blanks per minute. Blank maximum capacity is equal to a blank $\frac{1}{2}$ inch in diameter and 6-inch length under the head. Maximum length of wire cutoff on the long stroke machine is 8 inches.

Greater production can be achieved on the short stroke machine in cases where only short work is required. Operating at a production rate of 100 blanks per minute, the maximum blank capacity is equal to a blank of $\frac{1}{2}$ inch in diameter and $3\frac{1}{2}$-inch length under the head. Maximum length of wire cutoff on the short stroke machine is $5\frac{1}{2}$ inches. Previously, open die headers were required to form blanks of comparable size, resulting in slower speeds; extrusion was not possible and a fin was produced where the dies came together.

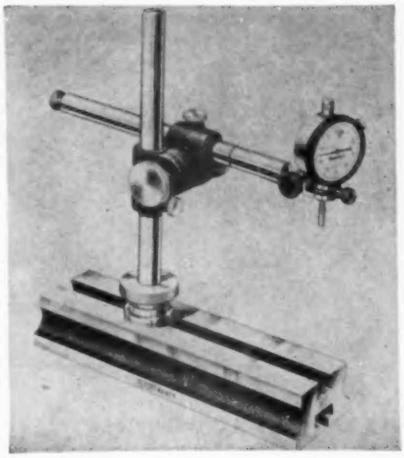
Filtered, automatic lubrication is employed throughout the unit, with force feed to stations requiring full flow, and metered systems to those requiring less oil. T-1-1562

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Dial Indicator

Extreme rigidity plus universal adjustment to any position are the main features of the heavy-duty dial test indicator No. 675, introduced by The L. S. Starrett Co., Athol, Mass. A Substantial base with ample weight to support the indicator unit measures 3 x 10 inches. It is made of cast iron with top and bottom faces accurately ground and has a T-slot extending the entire length of the lower face for attaching to machine tables.

The upright post ($10\frac{1}{2}$ x 0.750-inch diameter) slides in a dovetailed slot. It can be positioned at any point along the base without shake or side play and locked in place. It also can be quickly positioned at the desired height and



angular adjustment in a horizontal plane, as well as at the proper angle.

Another feature is the indicator clamp which permits facing the indicator in any direction.

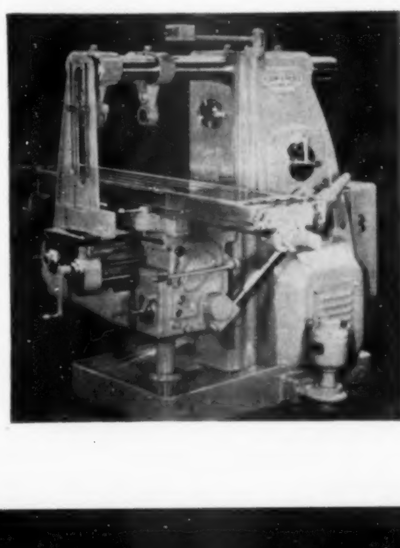
The gage is regularly furnished with Starrett No. 25-131 dial indicator, graduated 0.0005 inch, dial reading 0-25-0, range 0.125 inch, contact point 3/4 inch long. Other A. G. D. indicators can be furnished and are readily interchangeable. **T-1-1571**

Milling Machines

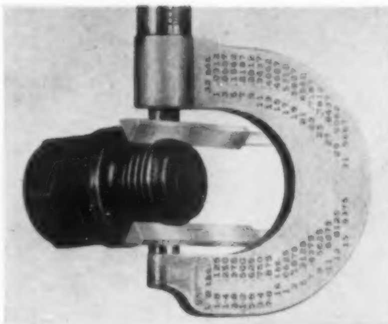
Introduction of a line known as Model CE milling machines combining quality with low initial cost has been announced by the Kearney & Trecker Corp., 6784 W. National Ave., Milwaukee, Wisc.

Offered in both plain and universal styles, this unit, which is suited to a wide variety of applications, provides three important features: efficiency, ease and economy of operation.

At present, this economical CE is immediately available in either No. 2 (3 hp) or No. 3 (7 1/2 hp) size. Both sizes feature 16 quick-change speeds (25 to 1300 rpm) and feeds (1/2 to 25 rpm). It is suitable for a wide variety of applications. **T-1-1572**



Thread Measurement



All threads, whether standard or nonstandard, may be readily calculated with the thread measuring tool for machinists, offered by Montgomery Tool Sales, Box 1241, Church St. P.O., New York 7, N. Y.

These thread triangle gages are two hardened and ground triangular-shaped bars, which are set over and under the threaded part. A micrometer reading, taken over the triangles, is checked against the sum of the nominal OD of the thread and the chart factor.

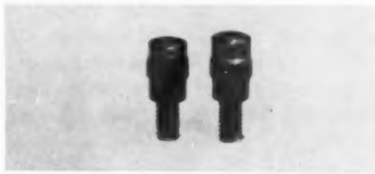
Advantages of the thread triangles include accuracy equal to the three-wire method; ease and simplicity of use; time savings; no chance of calculating errors; low initial cost and no maintenance, expensive repairs or replacements.

The tool works on all 60-degree threads from 4 to 56 pitch, standard thread or nonstandard thread, and may be used on any OD. T-1-1581

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Dial Indicator Points

A boron carbide tipped dial indicator point for use in production, multiple or automatic gaging offers considerably increased wear life. The indicator points are particularly suited to production gaging because hardness assures gaging stability due to the greatly



reduced need for gage readjustment. They retain a smooth finish after extensive use, yet will not mark or scratch the work.

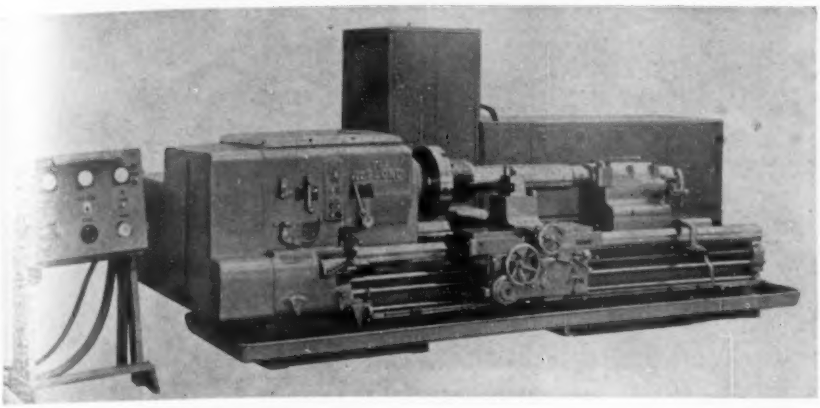
The points are made with spherical, conical or flat faces, and are readily interchangeable with steel or other points of American Gage Design dimensions.

Manufactured by The Robert Marks Co., the boron carbide points are distributed in the United States solely by Tooling Associates, P. O. Box 945, Providence 1, R. I. T-1-1582

Heavy Duty Lathe

The R. K. LeBlond Machine Tool Co., Cincinnati 8, Ohio, has announced development of a 32-inch heavy-duty engine lathe equipped with a 125-hp motor.

Condensed specifications of the 32-inch lathe include: 125-hp, 2-speed d-c motor; infinitely variable speeds from 42 to 1400 rpm; 56 feeds from 0.002 to 0.250 ipr. Four-directional power rapid traverse is built into apron. Tests of the new machine show 118 horse-



Hack Saw Blade

Truflex, a shatterproof hand hack saw blade, has been announced by The Capewell Mfg. Co., 60 Governor St., Hartford 2, Conn.

Made from a special-analysis high-speed steel, the blade has a hardened tooth edge to eliminate stripping, combined with a soft, tough back to make it a nonshatterable safety blade.

Designed to cut tough metals easily and with complete safety, they are available in three constructions: 18, 24, and 32 teeth per inch. Literature may be obtained from the maker. **T-1-1593**

power consumed at the cut.

Details of the test are: 12½-inch diam, 48 inches long, SAE 1045, Brinell 200 plus; 205 sfpm with surface meter; 63 rpm with tachometer; 0.083-inch fpr; 1-inch depth of cut; 2-hp reading on meter before cut; 120-hp reading on meter during cut.

Further information can be obtained by writing the company. **T-1-1591**

142-Tapping Attachment

A reversible unit for high-speed thread cutting with small taps is being made by Homestrand Inc., 9 Addison St., Larchmont, N. Y.

Its unusual design minimizes rotating parts, eliminating all gears. An axial ball bearing functions as a planetry gear transmission for reversing. Drive clutches are of the tapered type and are so combined with the axial ball bearing that the tap can be started slowly in both directions, regardless of spindle speed.

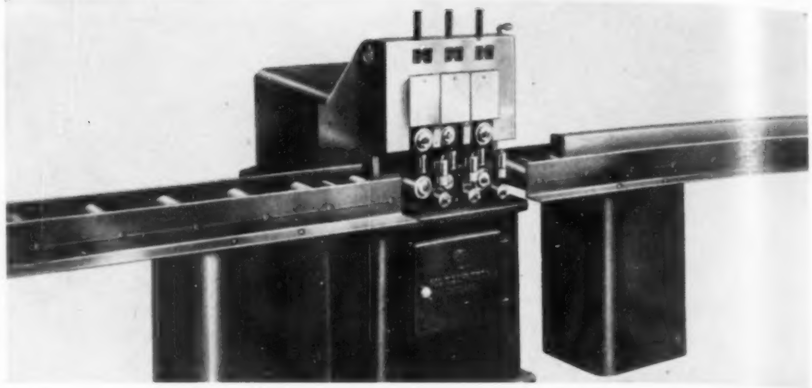
The attachment is available with Morse or Jacobs tapers as well as for cover clamping. The spindle can be furnished either with regular or collet chuck. **T-1-1592**

Bar Marker

Continuous marking on flat, square, round or octagonal bar stock is solved by a continuous bar marking machine built by Geo. T. Schmidt, Inc., 1810 Belle Plaine Ave., Chicago 13, Ill.

This unit, Model 295, provides a means of permanently identifying bar material, eliminating trouble of hand stamping, stenciling or the paint system of identification.

Operation is simple; the bars are fed between the rolls of the machine from which they are ejected after marking.



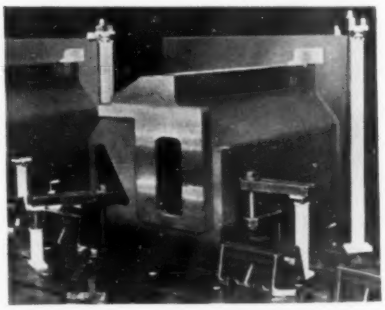
Flat, square, round, octagonal and structural or extruded shapes are handled equally well at speeds varying from 70 to 210 fpm. Speed is controlled by a simple handwheel. Capacity of the machine is from $\frac{1}{4}$ to 3 inches.

Both perpendicular and horizontal adjustment of the guide rolls are simple matters. T-1-1601

Clamp Posts

Machine setups can be made quickly and easily with an adjustable clamp post developed by the Ingersoll Milling Machine Co., Rockford, Ill., to help support workpieces during machining operations.

Suitable for most kinds of machines, clamp posts are designed for use with hold-down clamps to keep work rigidly



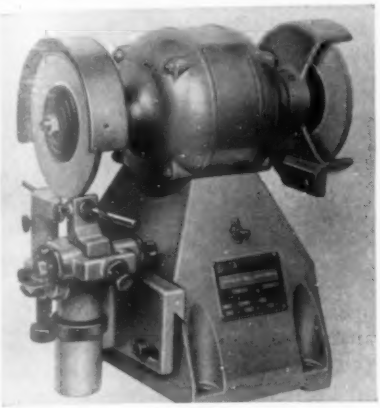
in position. By replacing makeshift setup equipment, such as metal or wood blocks and posts, they reduce machine setup time for a wide range of milling, boring, planing and drilling operations.

Clamp posts are produced in 4, 7 and 12 inch standard sizes, adjustable to heights of 7, 12 and 22 inches respectively, and in special sizes. Easy to handle and use, they have $\frac{1}{2}$-inch increments and are raised by simply lifting and turning the stem. They also can be stacked in different combinations to meet varying height requirements. T-1-1602

Drill Sharpener

...on Twist Drill Co., Athol, Mass., has now announced its availability to the trade on a general distribution basis as part of the company's regular line of cutting tools, the drill sharpener they developed some time ago for use in their own plant.

This drill point grinder provides a fast, accurate method of grinding crankshaft points (from 250 to 300



drills per hour) on drills ranging in size from #1 through #50, A through U, and 5/64 through 3/8 inch.

The fully enclosed unit is only 19 x 12 inches of bench space.

Advantage of crankshaft pointing is that the drill point is notched in such a way that the usual chisel edge becomes a pair of secondary cutting lips, leaving virtually no web thickness at the center, improving the cutting action.

Form Number 1011, available from the company, provides further information. **T-1-1611**

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Beryllium Alloy Wire

Little Falls Alloys of 194 Caldwell Ave., Paterson, N. J., has announced development of a high conductivity beryllium copper alloy wire called Silvercote No. 10. The alloy is composed of 0.5-percent beryllium, 2.5-percent cobalt and the balance, copper. It has 65 to 70-percent conductivity of copper and will resist fatigue from flexing and vibration while withstanding higher temperatures than ordinary copper wire.

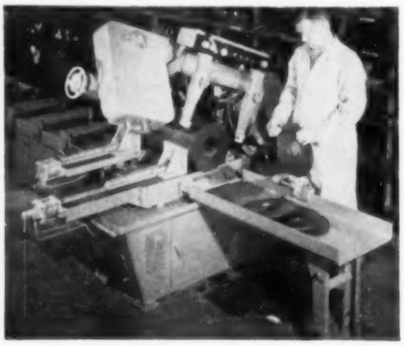
A light silverplating makes it easy to solder and also makes it possible to apply the new-type insulating materials that require higher curing temperatures than tinned wires can stand. **T-1-1612**

Cutoff Saw

Unusually high cutting rates achieved by the recently developed Demon high-speed steel saw band on contour sawing machines, prompted The DoAll Co.'s design of a power cutoff saw.

DoAll has incorporated into this power saw (their first entry into this field) several features and improvements to meet the cutting capabilities of this band tool.

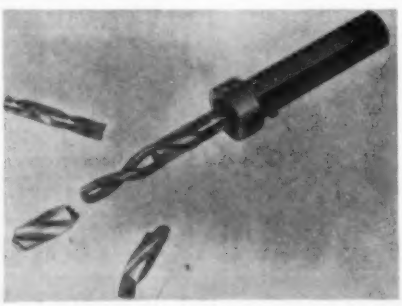
A whole set of exclusive adjustments and hydraulic controls for feed pressure, band tensioning and infinitely variable speed change, make the cutoff task simpler, faster, more accurate and, at the same time, more economical from the standpoint of man-hours and tool use. The machine is available with either manual or completely automatic stock indexing. Standard automatic indexing affords production of blanks up to 24 inches long. With slight modification automatic indexing for blanks of any reasonable length can be provided.



Literature is available from the company, Des Plaines, Ill. **T-1-1621**

Drill Extractor

Removal of drills that have been broken in a hole during drilling can be accomplished quickly and easily by any worker with the twist drill extractor designed by Wohlnip Engineering Co., 390 Hillside Ave., Hillside, N. J. The tool, which requires no other machine, equipment or tools, is made up of a center guide, extractor wires, housing



an collar. In use, the extractor w e inserted as far down into the h und the broken drill as possi- bl uper manipulation loosens the b drill and permits its easy with- dr

wist drill extractors are fur- n n sets of six different-sized ex- tr : the complete set will recover b drills from ⅛-in. diameter up to fr s to ½ in. inclusive. **T-1-1631**

Angle Computer

Angle Computer Co., Inc., 1709 Standard Ave., Glendale 1, Calif., has made a precise compound angle computer. The device, available in five models is accurate to one moment of the arc in each of three planes—horizontal, vertical and radial. It offers the possibility of reducing inspection time as much as one-half to one-tenth over the intricate sine bar method and its use may be taught quickly to inexperienced workers.

All protractors are graduated from 0 to 90 degrees in four sections of the

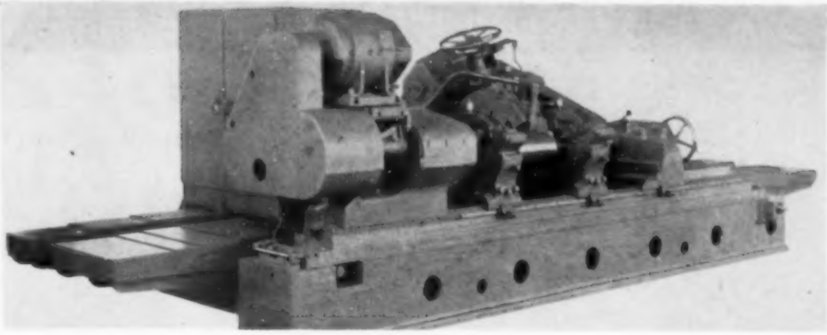
circle. The horizontal protractor is equipped with two verniers set at 90 deg apart, so that a reading can be taken at any position. The vertical and radial protractors have one vernier each. With Model "E" the universal compound angle plate permits use to lay out, machine and check work without removing the work from the plate. This instrument holds work in any position and requires no holding fixtures.

T-1-1632

Roll Grinder

A roll grinder for rolls weighing up to 25,000 pounds is announced by Landis Tool Co., Waynesboro, Pa.

In operation, the wheel is traversed



across the face of the roll, and crowning and concaving of rolls can be done to precision limits. A swivel table under the work head and footstock permits grinding of tapers.

This roll grinder is made to swing 36-inch diameter work. Lengths between centers are 120, 144, 168, 192, 216 and 240 inches. The 36-inch diameter grinding wheel is driven from a 40-hp motor. Traverse of the wheel head is variable from 2 to 100 ipm. Massive in construction, these 36 x 144-inch machines weigh more than 100,000 pounds.

All operating controls are located at

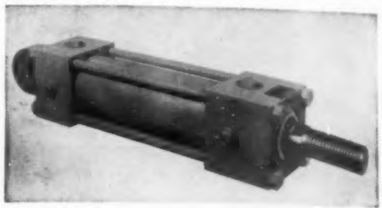
a central station beside the grinding wheel where the operator has a seat. Crowning and concaving to mathematically accurate curves is easily set at the rear of the machine.

Work speeds of the V-belt driven headstock are variable from 12 to 100 rpm. Work drive is 7½ or 10 hp, depending on the diameter of the roll neck. T-1-1641

Cylinders for Automation

The Hydro-Line Mfg. Co., 5768 Pike Road, Rockford, Ill., recently announced a line of cylinders called the Series "S," for automation application, that can be operated by either air or oil at operating pressures up to 1000 psi.

These units comply with both the JIC pneumatic and the JIC hydraulic standards. New "U" cup seals used on



the piston and the rod have flexible lips to assure positive sealing at low air pressures and heavy web sections for strength required for sealing pressures up to 1000 psi.

Design incorporates the piston rod seal and rod wiper in a single cartridge which is easily removed to replace seals or wiper when required. Cushions prevent internal damage and excessive noise at the high speeds required in modern automation programs.

The Series "S" cylinders are offered in bore sizes from 1½ to 8 inches and in seven different mounting styles as standard catalog items. Any stroke length is available. T-1-1642

Grinder Dogs

Cam-action dogs that are easy to adjust, and have an instant, positive action and protect the surface of work, are being made by Ready Tool Co., 554 Iranistan Ave., Bridgeport, Conn. They are supplied with brass cams and brass screws as well as hardened steel cams and screws. A concealed spring holds the cam to the work and the harder the drive, the tighter the grip.

Cams are ground smooth for greater protection of work finish.

In use, these Red-E cam-action dogs save time and labor, especially on semi-automatics or where there is little traverse feed, for all that is required

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

Literature Number	COMPANY	DESCRIPTION
A-1-169	Acme Industrial Co.	**Drilling and Reaming Bushings**—Catalog and price list contain information on bushings and all other machines and products. (Page 169)
A-1-240	Allegheny Ludlum Steel Corp.	**Die Steels**—Folder gives all needed handling and shop treatment details on Huron steels. (Page 240)
A-1-13	American Drill Bushing Co.	**Drill Jig Bushings**—New catalogs show complete line of American products. (Page 13)
A-1-236	American MonoRail Co.	**Cranes**—Bulletin C-1 illustrates many successful Mono Rail installations. (Page 236)
A-1-12	The American Tool Works Co.	**Radial Drills**—Advantages of American Hole Wizard are illustrated and described in Bulletin 327. (Page 12)
A-1-163	Armstrong-Blum Mfg. Co.	**Hacksawing Machines and Blades**—Catalog C-55 describes 11 different series of metal-cutting sawing machines and high-speed edge hacksaw blades and hole saws. (Page 163)
A-1-182	Barnes Drill Co.	**Honing Tools and Abrasives**—Catalog 500G discusses the advantages and construction features of Barnesdril honing tools. (Page 182)
A-1-174	Barnes Drill Co.	**Coolant Filters**—Catalog 350G tells of the advantages of the Barnes 2 stage Coolant Filters. (Page 174)
A-1-186	Edward Blake Co.	**Tap Sharpeners**—Catalogs discuss the Blake chamfer grinders and Flute grinding machines. (Page 186)
A-1-57	Boston Gear Works	**Gear Products**—Catalog lists 102 product groups and includes 30 pages of engineering data. (Page 57)
A-1-227	Buhr Machine Tool Co.	**Special Machinery**—Forty-eight-page catalog explains the 5-way automatic indexing dial-type machine which performs 18 operations. (Page 227)
A-1-194	Burg Tool Mfg. Co., Inc.	**Turret Drills**—Bulletin TE-1 discusses a power indexing mechanism and explains how costs of drilling, tapping, threading, etc. can be cut. (Page 194)
A-1-206	Consolidated Machine Tool Corp. Modern Tool Works Division	**Collapsible Tap**—Complete details of MC Tap are given in Bulletin M-113. (Page 206)
A-1-64	Crane Packing Co.	**Lapping Machine**—Possibilities of production lapping and a method measuring surface flatness are discussed in illustrated booklet. (Page 64)
A-1-158	H. E. Dickerman Mfg. Co.	**Di-Feeds**—Information on Rol-Di-Feeds and the complete Dickerman line are contained in illustrated literature. (Page 158)
A-1-221	Eastman Kodak Co.	**Contour Projectors**—"The Kodak Contour Projector" explains how this projector can solve measurement and inspection problems. (Page 221)
A-1-224	Erickson Tool Co.	**Mandrels**—Catalog K gives solutions to a variety of internal holding problems. (Page 224)
A-1-25	Gisholt Machine Co.	**Buying and Renting Machine Tools**—Booklet discusses leasing and time-payment plans, makes cost comparisons, discusses depreciation under the new tax codes, replacement programs and the MAPI formula for machine replacement. (Page 25)
A-1-168	George Gorton Machine Co.	**Pantographs**—Booklet "Pantography" describes the various operations, materials which can be cut, and their shapes with a Gordon Pantograph. (Page 168)
A-1-231	Greenfield Tap and Die Corp.	**Taps**—A revised "Facts about Taps and Tapping" offers a technical discussion on taps and factors which affect threading results. (Page 231)
A-1-177	Hammond Machinery Builders	**Carbide Tool and Chip Breaker Grinders**—Catalog discusses the various types of grinders and the economies possible through their use. (Page 177)
A-1-59	Hannifin Corp.	**Air Cylinders and Controls**—Catalog "Control Valves" and "Fluid Power Cylinders" are offered to give readers a detailed background of these products. (Page 58-59)
A-1-51	Kearney & Trecker Corp.	**Special Machinery**—Details for Kearney & Trecker two-way boring and milling machine are discussed in data sheet 1015. Booklet "A Doorway to a Proven Method for Solution of Big and Small Metalworking Problems" is also available. (Page 51)
A-1-24	Keller Tool Co.	**Ring Former**—Information concerning Keller's ring former for speeding production brazing of cylindrical parts is available in bulletin 51. (Page 24)

USE THIS HANDY FORM ➔

to obtain further information about advertisers, trade literature or tools of today appearing in this issue of THE TOOL ENGINEER. No postage needed.

155 ***THE TOOL ENGINEER, DETROIT 38, MICH.***

READER SERVICE CARD

Please send me further information as indicated below:

(Mark Key Number of trade literature, tools or advertisements)

ADVERTISERS	TRADE LITERATURE	TOOLS OF TODAY
A—	L—	T—
A—	L—	T—
A—	L—	T—
A—	L—	T—

NAME ____________ POSITION ____________

FIRM ____________ BUSINESS ____________

Please Check One ☐ Firm Address ☐ Home Address STREET ____________

CITY ____________ ZONE NO. ____ STATE ____________

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

Literature Number	COMPANY	DESCRIPTION
A-1-260	Lepel High Frequency Laboratories, Inc.	**Induction Heating Units**—Thirty-six page illustrated catalog contains information on high frequency induction heating. (Page 260)
A-1-242	Lindberg Engineering Co.	**Carbo-nitriding Furnaces**—Bulletin 241 describes advantages obtainable with Lindberg furnaces. (Page 242)
A-1-214	Metal Carbides Corp.	**Carbides**—New 84-page catalog 55-G shows the shapes, manufacturing specifications and mounting techniques applied by Talide in their carbides. (Page 214)
A-1-183-2	Morton Machine Works	**Fixture Clamps and Details**—Complete line of products and full-size tracing templates of each are supplied in catalog 4. (Page 183)
A-1-188	Nelco Tool Co., Inc.	**Carbide Tipped End Mills**—New 48-page catalog gives the various sizes and shapes of carbide-tipped end mills. (Page 188)
A-1-189	The New York Air Brake Co.	**Hydraulic Motors**—Bulletin DM-301 describes Dudco Dual-Vane Fluid Motors. (Page 189)
A-1-21	Niagara Machine & Tool Works	**Shears and Presses**—Eight bulletins are available which describe the various products of Niagara. (Page 20-21)
A-1-50	The Ohio Knife Co.	**Machine Ways**—Comprehensive bulletin of OK Ways is obtainable from Dept. 31-U. (Page 50)
A-1-47	Ortman-Miller Machine Co.	**Air and Hydraulic Cylinders**—Catalog explains cylinder features and set of ½ and ¼ scale templates showing all cylinders, mounts and mounting brackets. (Page 47)
A-1-152	The Parker Stamp Works, Inc.	**Hydraulic Marking Machines**—Complete information concerning the Parker 650 Marking Machine is available in booklet. (Page 152)
A-1-146	Pope Machinery Corp.	**Spindle Repairing**—Spindle Repair Bulletin E-1 points out Pope's records of repairing spindles. (Page 146)
A-1-34	Rehnberg-Jacobson Mfg. Co.	**Drill and Tap Units**—Literature describes units in detail and gives application examples. (Page 34)
A-1-225	Rivett Lathe & Grinder, Inc.	**Hydraulic Valves**—Catalog shows why Rivett gasket-mounted solenoid pilot valves are effective; illustrates flow examples for all piston designs. (Page 225)
A-1-160	Sheldon Machine Co., Inc.	**Toolroom Lathes**—Catalog G-55 illustrates and includes specifications for 10, 11 and 13-inch precision lathes—bench, cabinet and pedestal base models. (Page 160)
A-1-151	Sibley Machine & Foundry Corp.	**Drilling Machines**—Catalog 68-A discusses advantages and operating features of Sibley drill presses. (Page 151)
A-1-215	Simonds Abrasive Co.	**Abrasive Segments**—Catalog bulletin ESA-188 describes segments for surface grinding and machine knife grinding. (Page 215)
A-1-55	Sundstrand Machine Tool Co.	**Special Milling Machines**—Facts on the complete line of Sundstrand machine tools are contained in bulletin 751. (Page 54-55)
A-1-153-2	Twentieth Century Mfg. Co.	**Reamers**—Advantages possible with Supercam reamers are told in bulletin No. 10. (Page 153)
A-1-262	U. S. Tool Co., Inc.	**Multi-Slide Machines**—Specifications for U.S. Multi-slides are covered in bulletin 15-T. (Page 262)
A-1-155	Vlier Engineering, Inc.	**Torque Thumb Screws**—Production savings and construction features are explained in catalog No. 53. (Page 155)
A-1-213	Wales-Strippit Corp.	**Punch and Gage Assemblies**—Illustrated PPG bulletin describes economies available with this assembly. (Page 213)
A-1-198	S. B. Whistler & Sons, Inc.	**Perforating Dies**—Illustrated catalogs show economy and versatility of Whistler methods. (Page 198)
A-1-208	Wiedemann Machine Co.	**Punch Presses**—New R-61 bulletin describes application, operation and construction of the Turret Punch Press. (Page 208)
A-1-173	Wilson Mechanical Instrument Div. American Chain & Cable	**Hardness Testers**—Literature contains prices and describes Model Y motorized Wilson "Rockwell" Hardness Tester. (Page 173)
A-1-237	Zagar Tool, Inc.	**Drill Jigs**—Bulletin E-1 describes the versatility of Zagar self-clamping drill jigs. (Page 237)

BUSINESS REPLY CARD
No postage stamp necessary if mailed in the United States

FIRST CLASS
PERMIT NO. 10782
(Sec. 34.9, P.L. & R.)
DETROIT, MICH.

THE TOOL ENGINEER

ASTE Building

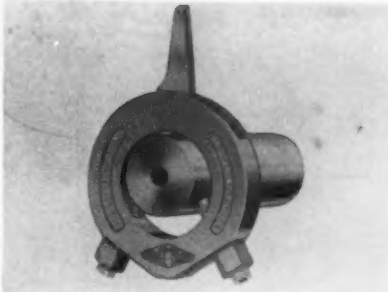
10700 Puritan Ave.

Detroit 38, Mich.

ATT. READER SERVICE DEPT.

USE THIS HANDY FORM

to obtain further information about advertisers, trade literature or tools of today appearing in this issue of THE TOOL ENGINEER. No postage needed.



is to place the work in the dog, holding the cam against the spring tension with a finger, and set the two screws. Release the cam, and the work is held securely by the spring action. Removal of the piece is equally simple.

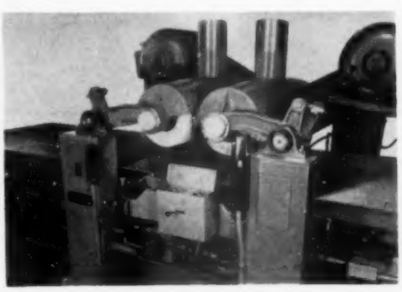
The cam dogs are available in sizes to accommodate diameters from 1/8 to 4 inches; steel cams and screws are supplied, unless brass cams and screws are specified. **T-1-1671**

Disk-Wheels

Fast, deep cutting action with unusually long wheel life is the outstanding feature of Bay State Abrasive Products Co.'s latest development, the "BZ" resinoid bonded disk-wheels. Made to withstand heavy pressures and harsh dressing action under high power at recommended speeds, these "BZ" disk-wheels offer three portable grinding advantages: their resinoid bond construction and multi-layer reinforcement of fibre glass plus specially treated nylon mesh, provides them with extra strength to stand heavy-duty grinding; their availability in a range of grades allows a choice of hardnesses to meet the requirements of various grinding jobs; all grades possess durability, giving longer wheel life on any kind of job. **T-1-1672**

Polishing Machine

A series of tandem roll horizontal polishing machines has been added to the line made by Central Machine Works, Worcester, Mass. Features of these machines include electrohydraulic controls, the patented hydraulic contour device for automatically following the



contours of shaped pieces, and the tandem roll arrangement which permits rough cut, or cut-down, and finishing at only one work setup. The machines are designed to handle extrusions of all types, sheets, plates, rods, tubing, and many odd-shaped items.

Polishing rolls are motor powered. Stroke is from two inches to full capacity of machine in stepless increments. The hydraulic contour device is standard equipment on all machines. Work or fixture table is available in any width or length, depending on the size of work to be finished. The table may be oscillated crosswise at the will of the operator. T-1-1681

Milling Chucks

Having acquired manufacturing and distributing rights to the Jahrl milling chuck in the USA, the J & S Tool Co., Inc., W. Mt. Pleasant Ave., Livingston, N. J., has now introduced this tool to the American market.

This milling chuck, called the JAL, provides a method of holding milling cutters with cylindrical shanks in modern machine tools so that they do not slip or draw out of the chuck.

The inner taper of the nose does not rotate against the matching taper of the collet, preventing loss of constrictive power while increasing the clamping effect.

The clamping nut is designed to reduce friction when tightening the chuck and to clamp the tool more securely.

Since the collet is not submitted to any radial force while the chuck is being tightened, because the collet nose moves only axially on a cylindrical guide, cutters are clamped in true center. The locking taper of the collet, which provides the chuck with increased clamping power, is released automatically when the clamping nut is turned counterclockwise one revolution.

T-1-1682

Bearing Material

A bearing material which operates at temperatures of -120 F to $+500$ F, manufactured by Booker-Cooper, Inc., 6940 Farmdale Ave., North Hollywood, Calif., offers excellent wear characteristics at extreme temperatures and also provides a superior bearing when used in conjunction with oil.

In oil applications, the solid lubricant of moly, graphite, etc., has oil retention and absorption values which provide a wicking action to supply the bearing surfaces with a lubricative film.

The material contains over 40-percent lubricative solids; has an ultimate compression strength of 22,700 psi, and can be machined to close tolerance.

T-1-1691

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Lifter

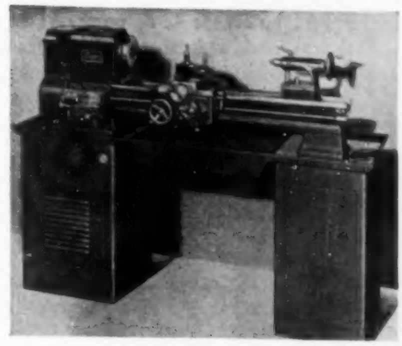
An unusual materials handling device that avoids necessity of slings and hooks in lifting or moving operations while providing added safety to the operator and the product, has been developed by Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

The device, called the Vac-Lift, provides a method for handling flat, nonporous materials. On any operation where material is moved by hand or by a sling or hook, the vacuum cup lift is a practical substitute.

Merely placing the vacuum cup on the work creates a safety-tight seal. Easy one-hand operation permits accurate spotting of the load. The operator releases the load with finger-tip control.

Components of this unit include the Ingersoll-Rand Air-Bloc Hoist, a compact, easy-to-operate pendant throttle, and a specially designed vacuum cup. No special vacuum system is needed since the air that operates the hoist creates the vacuum. The load is also released by air. **T-1-1652**

Swing Lathes



Production of a line of 12-in. swing lathes that feature unusual smoothness in operation has been announced by the Lathe Div. of Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill.

Eight lathes, four turret and four screw cutting models, make up the line which is identified as the "2500."

Extra strength has been incorporated in the units through wider gears, larger shafts, heavier supports, etc., with a

consequent increase in power and smoothness and a minimum of vibration.

A further feature of the line is the redesigned cabinet base which has a drop center chip pan of greater capacity.

An illustrated folder, available from the company, contains further details.

T-1-1701

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Deburring Tool

Development of a versatile deburring tool that removes burrs from top and bottom of holes without reversing the part, has been announced by Cogsdill Tool Products, Inc., 12980 Eight Mile Rd., W., Oak Park, Mich.

Where mass production is necessary the tool, called Burraway, may be used in single or multiple-spindle automatic machine tool equipment. Where production runs are smaller the Burraway gives the same results when used in hand-power equipment. A simple adjustment prefits blade pressure to the size of the chamfer required. The tool is then fed in and out of the hole without reversing the part.

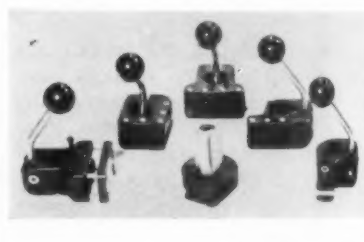
Compact and practical in design, the unit is easy and inexpensive to service. It is engineered and manufactured in a wide range of sizes. **T-1-1702**

Toolholder

A quick-change Sabre toolholder, based on the principle of drawing together two hardened surfaces by means of wedging cam action to assure consistent repetitive tool use, has been designed by Adams Equipment, 4200 W. Burbank Blvd., Burbank, Calif.

Design of toolholder provides 30-percent less overhang, permitting heavier cuts with less chatter.

Handle knobs not only provide quick and safe tool change, avoiding necessity of teardown and setup, but also reduce cut hazards when changing tools.



Using these units, tools either may be left in the holder for grinding, or may be mounted on an extra tool post at the grinder for form grinding.

All general machining operations may be performed with five basic toolholders and repetition is guaranteed to 0.0003 or less. The holders are available in two basic sizes: Series A for 9 to 13-inch lathes with $\frac{1}{2}$-inch tool bit capacity and Series B for 13 to 20-inch lathes with $\frac{3}{4}$-inch tool bit capacity.

T-1-1703

Abstracts of FOREIGN LITERATURE

By M. Kronenberg
Consulting Engineer

Tests with Cast Milling Cutters

Milling cutter castings made of chromium based alloys of steel with additions of tungsten, vanadium, molybdenum and cobalt were tested at the Institute of Technology at Darmstadt according to a report by C. Stromberger in the October 1954 issue of *Werkstatt und Betrieb*.

The teeth were cast integral with the body on the two types of cutters used, namely, helical cutters and slab mills. Test blocks were made of steel similar to SAE 1045 and a uniform cutting speed of 75 fpm was employed. The width of the cut was likewise kept constant, namely, 1 inch for the helical cutter and 3/4 inch for the slab mill. Feed rate and depth of cut were varied. Flank wear was measured after three cuts comprising a total length of 8 feet per test run.

Flank wear of 0.0063 inch was taken as a criterion for tool life, which is a conservative figure. The slab mill gave a tool life of 220 min. with a depth of cut of 1/2 inch and a feed per tooth of 0.004 inch. The same tool life was obtained with a cut of about 3/16-inch depth and a feed per tooth of 0.008 inch in testing a helical cutter. The difference in metal removal per tooth is small for the two types of cutters, as is evident from the diagrams published with the article.

The author also encountered the so-called cascading progress of flank wear, as experienced by others in many cases, indicating that flank wear instead of constantly progressing often occurs in a rather step-like fashion—only suddenly increasing, while at other times in the same run increasing only slowly.

The author reports additionally that built-up edges failed to develop. Some trouble was due to notches on the cutting edges caused by chips sticking to the tooth and plastically deforming the edge. Cutting fluids proved to be useful because they helped wash away the chips, preventing or reducing notch formation at the cutting edges.

Needle Cage

The needle cage, not to be confused with a needle bearing and equipped with neither an outer nor an inner race, is built to support high velocity shafts under radial loads. G. Neese, in an article in Issue No. 10 of *Werkstatt und Betrieb*, describes the development of the needle cage in great detail. It runs smoothly due to the great number of needles, making no contact with one another, but held in position and requiring little space in the assembled machine.

It is claimed that the first needle cage was developed in the United States but has been improved by rendering it possible to prevent the needles from escaping to the outside. At first aluminum cages were made, because the windows for the needles could readily be stamped out of the ring; it was found, however, that small particles of the aluminum ring entered the cage, preventing proper functioning. The development of an M-shaped cross section of the cage made it possible to use steel instead of aluminum and to considerably increase the portion containing grease or lubricants.

The author reports that cages made of plastic material proved equally successful up to bearing temperatures of about 160 F. although the high tool costs are prohibitive unless these needle cages are produced in great quantities. In addition to these types, the author presents illustrations of special needle cages, such as duplex cages to be used where a single bearing would be too long for supporting the needles properly. Additional technical data in this article cover details on the dynamic loads and the static loads to be taken into account when designing machinery for needle cage application. Further information refers to the surface finish of the housing, runout, axial support of the shaft, pressure, tolerances, required clearance, lubrication, temperatures of the bearing, speed, friction data and shockproof design.

Distortion of Flame-Hardened Gears

C. H. Heise reports on an investigation of the distortion of flame-hardened gears in the October 1954 issue of *Werkstatts Technik*. The Peddinghaus method of rotating the gear in an atmosphere of heating gas and oxygen is used.

Tests covered the effect of the shape of the teeth, wall thickness, heat-treating temperature, heating time and annealing temperature. A cost comparison between flame hardening and standard heat treatments was also made. The finding was that flame hardening is considerably less expensive in all respects, when comparing the direct cost, labor

co... cost of transportation and other su... items. The cost of the equipment co... be amortized within 8 months.

The distortion tests were made with five different types of gears, including a spline shaft. A disk gear of 5 pitch and 32 teeth heated up to 1550 F for 120 sec. failed to show any distortion of the outside diameter and the width of the teeth, while the runout at the face of the teeth increased from 0.0008 inch to 0.0016 inch. The shape of a pinion on a shaft was unaffected by flame hardening. In a bevel gear the distortion of the outside diameter was less than the admissible tolerance, while other dimensions were unchanged. Numerous other test results are discussed, particularly of parts that cause great trouble in standard heat-treatment processes due to small wall thickness or other reasons.

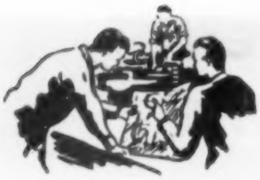
Surface Finish and Design

An analysis of the relationships between surface finish and design considerations will be found in an article by F. Goetze in the magazine *Konstruktion*, Issue No. 9, 1954. The author first defines the concept of the ratio of the true bearing area to the reference area. This is standardized abroad and determined under load per unit area, depending upon the modulus of elasticity of the test piece, according to German standards DIN 4760, 4762 and 7182.

Three criteria must be taken into consideration when determining surface finish, namely, surface shape, surface performance and surface texture. The latter is affected by the machining process or other processes of surface treatment. The crystal lettuce at the surface, (less than 4 millionths of an inch depth) is distorted and crushed in a metal-cutting operation but not in an electrolytic deposit. Accordingly, the two surfaces will show a different behavior with regard to cohesion, corrosion, bearing contact, friction, wear and endurance.

The article is illustrated with numerous diagrams, photos and tables. It deals in detail with producing surfaces of various qualities. Nomenclature indicates these qualities, in particular the relationship between surface quality and endurance limit, contact of surfaces, sealing of surfaces, wear and lubrication. It concludes with recommendations for improving the cooperation between the tool engineer and the designer to provide the best surface for every part in a machine.

Spanish **associated** company of Worthington Corp., Bombas y Construcciones Mecanicas, has opened a new plant in Madrid to produce a variety of pumps ranging from feed pumps for locomotives to vacuum pumps, as well as diesel engines and steam turbines.



Men at Work . . .

C. H. Ker, president of The Dalton Foundries, Inc., was elected president of The Gray Iron Founders' Society at its annual meeting. Other officers elected were J. W. Simmons, Jr. of Cox Foundry & Machine Co., vice-president; C. H. Meminger of Foundry Div. of Posey Iron Works, Inc., secretary; and W. O. Larson of W. O. Larson Foundry Co., who was re-elected treasurer.

Paul I. Birchard has been made vice-president and general manager of Westinghouse Air Brake Co.'s Le Roi Div. Previously Mr. Birchard was vice-president and general manager of the Enterprise Engine and Machine Co. He replaces **Edward J. Green** who had been temporary general manager of the Division since the resignation of T. O. Liebscher, former president of the LeRoi Co. LeRoi was reorganized as a division of Westinghouse Air Brake last October. Mr. Green will return to Westinghouse Air Brake headquarters to resume his position as executive assistant to the president.

Officers elected at the recent annual meeting of the National Tool and Die Manufacturers Assn. to serve for the coming year included **Jerome H. Stanek,** vice-president of Stanek Tool & Mfg. Co., as president; **Joseph N. Huser,** president of B & H Specialty Co., Inc., first vice-president; **Herbert Harig,** vice-president of Harig Mfg Corp., second vice-president; and **Harold G. Murdock,** vice-president of Arrowsmith Tool & Die Corp., secretary. **Philip R. Marsilius,** vice-president of The Producto Machine Co., was reelected treasurer of the organization. Messrs. Stanek, Huser, Murdock and Marsilius are members of ASTE'S Milwaukee, Fairfield County, Los Angeles and Indianapolis chapters respectively.

New president of the Ajax Electric Co. is **John E. Haig** who was elected at a meeting of the company's board of directors to succeed William Adam, Jr. who died recently. Mr. Haig was previously vice-president and secretary of the firm.

Robert Potter, vice-president and manager of the Salem, Ohio, Div. of E. W. Bliss Co. assumes the office of assistant executive vice-president on January 1. At the same time, **George Perrault, Jr.,** who has been sales manager of the Rolling Mill Div. at Salem, will become manager of the Salem Div.

The American Society of Mechanical Engineers, during their annual meeting elected **David W. R. Morgan,** vice-president on the headquarters staff of Westinghouse Electric Corp., to serve as president for the next year. New regional vice-presidents elected include **William H. Byrne** of Byrne's Associates; **James B. Jones,** head of the mechanical engineering department of Virginia Polytechnic Institute; **Ben G. Elliott,** chairman of the department of mechanical engineering of University of Wisconsin; and **C. H. Shumaker,** chairman of the department of industrial engineering at Southern Methodist University.

Milburn A. Hollengreen, president and general manager of Landis Tool Co., has been elected president of the National Machine Tool Builders' Assn. for 1955.

Condé Hamlin is now executive vice-president of DeWalt Inc., subsidiary of American Machine & Foundry Co. He formerly was vice-president in charge of sales.

J. A. Schaefer was elected to the newly created post of executive vice-president of Dreis & Krump Mfg. Co. He formerly held the position of sales manager.

Carl W. Petersen was elected vice-president and works manager of Dodge Mfg. Corp. He had been general superintendent of the company since 1942.

During its annual meeting, the National Machine Tool Builders' Assn. also elected **Louis Polk, Jerome A. Raterman** and **John C. Cotner** to serve as first vice-president, second vice-president and director, and treasurer respectively. Mr. Polk, who also is a member of ASTE's Dayton chapter, is president of Sheffield Corp.; Mr. Raterman is president of Monarch Machine Tool Co., and Mr. Cotner is president and general manager of The Hydraulic Press Mfg. Co.

Firth-Loach Metals, Inc., most recently organized carbide metal producer in this country, has appointed **Louis De Marco** as vice-president in charge of sales and engineering and **James E. Gray** as sales manager. Mr. De Marco was previously associated with Firth Sterling as assistant chief engineer of the Carbide Div., while Mr. Gray was formerly assistant sales manager of the same Firth Sterling division.

C. E. Amos has been named administrative assistant to the vice-president—production at Jones & Laughlin Steel Corp. Since 1951 he was assistant to the general manager of the ore mines and quarries.

Investment Casting Institute, at its annual fall meeting, elected **Ted Operhall** of Misco Precision Co., as president of the organization, and **Vincent S. Lazzara** of Castings Engineers, Inc. to serve as vice-president.

Directors of Vanadium-Alloys Steel Canada Ltd. have elected **J. Gordon Barker** to the company presidency. For the past seven years, Mr. Barker has served as an executive officer of Canadair Ltd. At the same time **J. P. Gill,** president of the American parent company, Vanadium Alloys Steel Co., and who has been serving as Vanadium Alloys Steel Canada president, became chairman of the board for the Canadian firm.

Joseph H. Humberstone, president of Air Reduction Sales Co., Inc. is the new president of the American Welding Society. Also elected at the organization's annual meeting were **J. J. Chyle** of A. O. Smith Corp., first vice-president; and **C. P. Sander** of Consolidated Western Steel Div. of United States Steel Co., second vice-president.

Two major honor awards also were conferred at the meeting. **A. F. Davis,** vice-president and secretary of The Lincoln Electric Co., was presented the Samuel Wylie Memorial Medal for outstanding contributions to the advancement of welding. **William L. Warner,** engineering research adviser of Watertown Arsenal was asked to present the society's honor Adams Lecture because of his outstanding work and because he has made a distinctive development in the field.

Two executive appointments have been announced by Logansport Machine Co., Inc. **E. L. Kimes** was made vice-president and treasurer, while **L. L. Austin** became vice-president and secretary.

Walter F. Hinkle has been elected vice-president of engineering for Acme Steel Co. Formerly director of engineering and research, Mr. Hinkle will continue to direct all engineering activities for Acme and also will be in charge of the mechanical and electrical divisions.

Appointment of **Harold J. Siekmann** to the office of vice-president has been announced by The R. K. LeBlond Machine Tool Co. Mr. Siekmann, who has been chief engineer of the company since 1944, will retain those duties in his new position.

Election of officers at the annual council meeting of the Instrument Society of America, made **Warren H. Brand,** director of engineering and research at Conoflow Corp., president of the organization for the next year. Vice-presidents elected for two-year terms were **A. A. Anderson,** president of Swissomatic Products and other Southern California firms, and **W. H. Fortney,** assistant superintendent of maintenance and construction at Humble Oil & Refining Co.

During the recent meeting of the board of directors of Mercast Corp. **Adm. Alan G. Kirk,** chairman of the board, was elected president of the corporation. He succeeds S. J. Sindeband who was recently made president of The Teleregister Co. Adm. Kirk, who has been chairman of Mercast's board for the past year, was the Ambassador to Russia during 1949-1952.

Trade Literature

For Free Booklets and Catalogs—
Convenient Request Card on Page 165

Gear Tolerances

Illustrated 8-page reference manual SC-1 lists standard tolerances for gear hobs; includes tables of standards for both single and multiple tread gear hobs, precision or commercial ground, accurate unground or commercial unground; also discusses precision inspection methods, shows comparative cost curves for ground and accurate unground form hobs. Star Cutter Co., 34500 Grand River Ave., Farmington, Mich. **L-1-1**

Brakes

"Handy Guide to Aid in Selecting and Operating Di-Acro Brakes" describes and illustrates variety of ways company's 10 models of standard, box finger and radius brakes can be set up for production or experimental forming jobs. Lists specifications and capacities for all brakes; illustrates how single unit can be simply converted for many uses. O'Neil-Irwin Mfg. Co., 625 Eighth Ave., Lake City, Minn. **L-1-2**

Machine Attachments

Brochure illustrates and describes broad range of precision tool attachments including turning tools, tap and dies holders, tool post and cutoff blade holders, knurling and recessing tools; covers specifications, design details, prices and other data. R and L Tools, 1825 Bristol St., Philadelphia 40, Pa. **L-1-3**

Air Tools

Well illustrated bulletin 38A presents broad line of air tools for foundry, steel mill, production line and assembly plant giving specifications, cross section and dimensional drawings; discusses uses and advantages. The Rotor Tool Co., Cleveland 23, Ohio. **L-1-4**

Materials Handling

Twenty-eight page illustrated treatise "Why the Small Fork Truck", deals with its use in connection with material handling efficiency for the small and medium sized plants. Covers space problems growing out of time and labor factors common to small plant operations and suggests solutions based on experience and actual results of previous applications. Request directly from Market Forge Co., Materials Handling Div., Everett 49, Mass.

Machine Tool Accessories

Forty-page catalog 5418 describes and illustrates complete line of attachments and accessories for precision toolroom and engine lathes, turret lathes, drill presses, bench shapers and pedestal grinders; covers special features, specifications and construction data. South Bend Lathe Works, 425 E. Madison St., South Bend 22, Ind. **L-1-5**

Knives, Blades and Accessories

Comprehensive catalog No. 22 describes company's products for machinery, metalworking, iron and steel, pulp and paper, and woodworking industries; illustrated with photos, drawings and tables; includes technical information necessary for ordering; covers techniques used in manufacturing operations of this line. The Ohio Knife Co., Dept. U-35, Cincinnati 23, Ohio. **L-1-6**

Tool Steels

Comparison chart shows general classification, SAE, AISI and JIC numbers for 15 different types of tool and die steels plus brand names used only by 12 mills. Uddeholm Co. of America, Inc., 155 E. 44th St., New York 17, N.Y. L-1-7

Lathes

Literature describes construction, operation and specifications of new 16 in. and new 20 in. LA lathes; third folder discusses Dinabrake motor outlining main features, advantages and uses. All illustrated. The Nebel Machine Tool Co., 3414 Central Pkwy., Cincinnati 25, Ohio. L-1-8

Die Sets

More than 300 sizes of ball bearing precision die sets offered in 192-page catalog covering die sets, guide post assemblies and accessories; includes descriptions, drawings, specifications; tab indexed for easy reference. Lempco Products, Inc., Industrial Div., Bedford, Ohio. L-1-9

Gages

Extended line of extreme tolerance gage block sets, sine bars, squares and accessory sets covered in 19-page illustrated catalog; includes general description and outline of uses. Jansson Gage Co., 13550 Auburn Ave., Detroit 23, Mich. L-1-10

Aluminum Extrusions

Illustrated brochure describes aluminum extrusion process, how extrusions are formed, advantages of the process, and six basic extrusion types; drawings clarify details. Precision Extrusions, Bensenville, Ill. L-1-11

Fasteners

Descriptions of line of Unbrako precision threaded fasteners presented in 32-page catalog; each type discussed as to features, uses and specifications; illustrated. Standard Pressed Steel Co., Jenkintown, Pa. L-1-12

Hydraulic Cylinders

Eight-page catalog 54-68 describes "Compact" hydraulic cylinders; contains installation drawings for each of five cylinder mounting styles available; includes engineering data, ordering instructions and charts for determining piston areas, speeds and output forces for cylinders. Vickers Inc., 1400 Oakman Blvd., Detroit 32, Mich. L-1-13

Casting Method

Informative, illustrated brochure explains work, use and advantages of frozen mercury process for making larger, more complex precision castings; step-by-step action photos clarify text; includes engineering drawings and charts. Mercast Corp., 295 Madison Ave., New York 17, N.Y. L-1-14

Steel Electrodes

Revised booklet, "Resistal (R) Stainless Steel Electrodes," covers information on welding stainless steels. Useful as reference when selecting proper grades of welding rod for given stainless grades; gives chemical and mechanical properties of weld deposits; discusses types of coating fluxes, gives details on welding procedure and other data. Crucible Steel Co. of America, Adv. Dept., P.O. Box 88, Oliver Bldg., Pittsburgh, Pa. L-1-15

Case Hardening

"How to Case-harden Tools" introduces powder created to provide a simplified method for quick-surface hardening of steel tools, dies, parts and cutting implements. Anti-Borax Compound Co., 1506 Wall St., Fort Wayne, Ind. L-1-16

Clutches

Line of clutches for over-running, backstopping and indexing applications presented in 20-page catalog; includes photos, application drawings and engineering and specification data for each class of the six standard lines; also gives information on selection, installation and maintenance. Formsprag Co., [illegible] Hoover Rd., Van Dyke, Mich.
L-1-17

Iron Castings

Pocket-size 36-page booklet "Glossary of Terms for Producers and Users of Iron Castings" explains more than 150 technical terms commonly used by suppliers and users of ferrous and non-ferrous castings. International Nickel, 67 Wall St., New York 5, N. Y.
L-1-18

Carbide Tools

Helpful information on use and care of carbide tipped tools contained in 24-page brochure; includes data on recommended speeds and feeds for drills and reamers plus illustrated instructions for regrinding; also describes and pictures enlarged line of drills for broad variety of purposes, reamers, counterbores and spot facers, and special carbide tipped tools. The Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio. **L-1-19**

Abrasive Wheels

Informative 40-page booklet "Why Abrasive Wheels Fail (Sometimes)" deals with that subject in simple, easy-to-understand way explaining causes of failure and preventions. Free only if requested on company letterhead directly from Wallace Tube Co., 1304 Diversey Pkwy., Chicago 14, Ill. **L-1-20**

Cast Stainless Alloys

Set of 13 data sheets covers properties of popular grades of alloys used for stainless steel castings; each sheet lists chemical composition, physical and mechanical properties and discusses design considerations. Alloy Casting Institute, 32 Third Ave., Mineola, N.Y. **L-1-21**

Gear Testers

All models of Mahr precision gear testing instruments described completely in 100-page book issued in connection with introduction of these gear testers into this country; includes information on most modern methods of testing and inspecting all types of gears and gear tables. Request only on company letterhead, including individual name and title, to George Scherr Co., Inc., 200 Lafayette St., New York 12, N.Y.

Air Motors, Valves

Dimensions and specifications of Bellows air motors and valves presented in 28-page Spec-Book; gives dimensional details to facilitate application of these parts; includes 75 illustrations and 27 specification charts. The Bellows Co., 222 W. Market St., Akron 9, Ohio.
L-1-22

Low-Temperature Alloys

Useful revised booklet "Cerro Alloys in Foundry and Pattern Shop" describes low temperature melting alloys used for various operations in foundry and pattern shop practice; well illustrated with photos and drawings. Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y. L-1-23

Adjustable Taps

Recently revised bulletin G-92-2 covers line of solid adjustable taps; includes detailed data on design, tapping ranges, dimensions and specifications, special taps; illustrated. Landis Machine Co., Waynesboro, Pa. L-1-24

Plant Layout

Thirty-two page illustrated booklet, "More Dollars from Less Space," shows how to fit more production units into smaller manufacturing area through the Alden Work Center system; explains principle of system, description of equipment, and gives actual application information. Alden Systems Co., Dept. 1., Alden Research Center, Westboro, Mass. L-1-25

Pressure Blasting

Two technical bulletins discuss "Cleaning Prior to Electro-Plating with Pressure Blast" and "Deburring with Pressure Blast"; both describe particular applications in detail; each accompanied by illustrated brochure covering manual and automatic equipment. The Cro-Plate Co., Inc., 747 Windsor St., Hartford 1, Conn. L-1-26

Guide Pins and Bushings

Twelve-page catalog features guide pin bushings and guide pins with photos of items, detailed dimensional drawings; outlines features and advantages offered; lists prices. Lamina Dies and Tools, Inc., P.O. Box 31, Royal Oak, Mich. L-1-27

Copying Lathes

Illustrated leaflet presents company's automatic multi-cycling copying lathe discusses design and construction features, dimensions, specifications and main advantages. H.E.B. Machine Tools, Inc., 475 Fifth Ave., New York 17, N.Y. L-1-28

Technical Shorts...

QUICK, ACCURATE determination of the hydrogen content in titanium metal and alloys can be accomplished through a technique developed by National Research Corp. Importance of the development lies in the fact that small concentrations of hydrogen in titanium and its alloys may have a critical as well as adverse effect of their physical properties. By discovery of the presence of the hydrogen content costly work on defective titanium or titanium alloys can be avoided.

Measuring Hydrogen in Titanium

The technique, which makes use of vacuum fusion gas analysis apparatus, enables determination of hydrogen content in less than 20 minutes. Accuracy, the researchers claim, is better than plus or minus 4 percent.

* * *

PEAKS AND VALLEYS ranging from 2 to 100 millionths of an inch will be measurable with the new type of microscope now being pioneered by General Motors Research Laboratories. This tool, known as the interference microscope, will undoubtedly prove useful, not only as a research tool, but as a quality control instrument where microscopic smoothness or roughness is essential. It differs from ordinary microscopes because it adds dimension of depth to the usual capacity to examine surfaces.

Microscope To Measure Microinches

The microscope utilizes an interference or split beam principle. A beam of light is directed into a block of glass which splits the light into two parts—one part is directed through a lens to a flat reflecting surface, the second is directed downward through another lens where it is reflected from the surface of a specimen under examination. After being reflected from the flat reflecting surface and from the specimen surface, the two beams return through their respective lenses to the beam splitter where they recombine to form an "interference pattern," or series of lines which tell the story. If the surface examined is smooth, the lines are even and parallel; if the surface is uneven or marred by machining marks or scratches, the lines are wavy and jagged. Depth of the scratches may be measured by their deviation from straight-line patterns obtained from absolutely smooth surfaces.

Already the new microscope has been used to measure plating thickness, to determine leveling abilities of plating materials, and to study effects of weathering on painted surfaces. In addition, it has been used to control precision roughness standards and also to check corrosion pits and other defects on plated parts and other surfaces such as cylinder bores and bearings.

RUPTURED OR DAMAGED piping can be fixed up in a minute temporarily because of the emergency solution developed by the Navy and described recently in the *Navy Technical News* bulletin. The development is a plastic patch that applies as simply as a first aid bandage on a cut. The patch is easily applied and can put a ruptured fire main pipe, or a cooling system back into operation in about 30 minutes.

Plastic Patches For Pipe Repairs

Tests seem to indicate that this metallic plastic pipe patch should be used only on salt or fresh water piping where pressure does not exceed 300 lb and where temperature does not go above 200 F. However, tests currently are being conducted to find methods of

applying the patch to lines carrying steam, gasoline or other materials.

The patch can be used on most types of ruptures, including sections of pipe that have been completely severed, a ruptured elbow or on a separated piece located on any curved section of pipe. It also applies to compound ruptures with protruding edges, or ruptures in fittings. Only 15 to 20 minutes are required to apply the patch and then pressure can be restored to the system within 30 minutes after application.

Materials used in the patching job are pliable and easily applied before hardening. This is of course only a temporary patch, but experience has shown that it will last satisfactorily until permanent repairs can be made.

* * *

Build Reactor For Industrial Use

FIRST NUCLEAR REACTOR for industrial research is to be established at Armour Research Foundation of Illinois Institute of Technology. It is expected to serve as a research tool that will bring direct benefits to industry for it will permit investigations into such fields as the high polymer studies of the structure of plastics, rubber and similar materials, glass and ceramics; wear and friction studies; and the development of metals and alloys.

The proposed reactor, which is designed for 50,000 watts, is specifically a highly flexible neutron and gamma source. Cost is anticipated to be approximately $500,000, about one-third of which investment will be assumed by the Foundation.

At present, there is only one reactor not devoted to AEC work; that is a 10,000-watt reactor at North Carolina State College. Although at least three more currently are being planned for educational and college research, the one scheduled for Armour Research Foundation is the first directed toward industrial research.

According to Dr. Richard F. Humphreys, manager of the physics research department and who will direct the project, an extensive research program will be conducted by the Foundation on problems of specific interest to the participating industries. Results of this research, including any inventions that may arise, will be made available to the participators.

Sponsored research will be subject to no security classification, no competition from military applications, and no secrecy other than that called for to protect individual sponsor's programs. In other words, the reactor will be free of all restrictions not called for by technical common sense.

Who's Meeting - and Where

Jan. 13-14. National Association of Purchasing Agents. Third Region conference for Midwestern purchasing agents, Jefferson Hotel, St. Louis, Mo. Direct inquiries to the association's St. Louis chapter, 3838 Market St., St. Louis, Mo.

Jan. 24-27. Plant Maintenance & Engineering Show. International Amphitheatre, Chicago. For details write to producers of the show, Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

Jan. 27-28. University of California, University Extension, sponsoring seventh annual industrial engineering institute. Details available from Prof. Edward P. Coleman, 4173E Engineering Bldg., University of California, Los Angeles 24, Calif.

Jan. 31-Feb. 11. University of California, Engineering and Management Course conducted by College of Engineering and School of Business Administration. Direct all inquiries about the course, registration, housing, etc. to Prof. Edward P. Coleman, 4173E Engineering Bldg., University of California, Los Angeles 24, Calif.

Feb. 8-9. Illinois Institute of Technology, Armour Research Foundation, co-sponsors with Chicago section of the American Welding Society. First annual Midwest welding conference. Institute's Metallurgical and Chemical Engineering Bldg., 10 W. 33rd St., Chicago, to study latest research findings in welding and new welding applications. Direct inquiries to Orville T. Barnett, supervisor of Foundation welding research, Illinois Institute of Technology, Technology Center, 35 W. 33rd St., Chicago 16, Ill.

Feb. 8-10. The Society of the Plastics Industry, Inc. Tenth annual reinforced plastics division conference, Hotel Statler, Los Angeles, Calif. For more details contact society office, 67 W. 44th St., New York 36, N. Y.

Feb. 18-19. National Society of Professional Engineers, annual spring meeting, Hotel Charlotte, Charlotte, N.C. All details are available from society office, 1121 15th St., N.W., Washington 5, D. C.

Feb. 22-23. Society of the Plastics Industry Canada, Inc. Thirteenth annual Canadian conference, Hotel London, London, Ontario, Canada. For more facts, contact society headquarters, 67 W. 44th St., New York 36, N. Y.

Mar. 10-11. Porcelain Enamel Institute. Pacific coast conference, Biltmore Hotel, Los Angeles, Calif. Get details from institute offices, DuPont Circle Bldg., 1346 Connecticut Ave., N. W., Washington, D. C.

Mar. 14-15. Steel Founders' Society of America. Annual meeting, Drake Hotel, Chicago. For details write society headquarters, 920 Midland Bldg., Cleveland 15, Ohio.

Mar. 14-18. American Society of Tool Engineers. 1955 Western Industrial Exposition, Shrine Auditorium and Exposition Hall, Los Angeles. Annual meeting to run concurrently, Ambassador Hotel and Shrine Auditorium. Complete information available from Society headquarters, 10700 Puritan Ave., Detroit 38, Mich.

Mar. 15-17. American Institute of Electrical Engineers, Power Division. Utilization of Aluminum conference, William Penn Hotel, Pittsburgh, Pa. Write to institute office, 36 W. 46th St., New York 36, N. Y. for more data.

Mar. 16-18. Pressed Metal Institute. Annual spring technical meeting, Hotel Carter, Cleveland, Ohio. Request details from institute office, 2860 E. 130th St., Cleveland, Ohio.

Mar. 29-Apr. 7. American Chemical Society. Spring meeting, Cincinnati, Ohio. Details may be had from society offices, 1155 Sixteenth St., N. W., Washington 6, D. C.

Apr. 5-7. National Fluid Power Association. Annual spring meeting, Colorado Springs, Colo. Get complete details from association office, 1618 Orrington Ave., Evanston, Ill.

Apr. 6-10. World Plastics Fair and Trade Exposition, Inc., National Guard Armory, Los Angeles. Get complete information from executive office, 8762 Holloway Dr., Los Angeles 46, Calif.

Apr. 13-15. Society of the Plastics Industry, Inc. Pacific Coast section conference, Palm Springs, Calif. Direct inquiries to society offices, 67 W. 44th St., New York 36, N. Y.

Field Notes...

Celebration marked The Cincinnati Milling Machine Co.'s 70th year in the field. Events for the anniversary included an open house reception, a tour of the modern engineering and headquarters building, main plant and other manufacturing facilities of the company, and a novel movie presentation.

√ √ √

Eighth **annual** competition of its engineering undergraduate design program has been opened for the 1954-55 school year by The James F. Lincoln Arc Welding Foundation. Papers of not more than 20 pages in length which treat welded design of a machine, machine part, structure or structural part are eligible for the competition. Top award of the 46 offered is $1,250. Information on conditions of the program is available from the Foundation, Cleveland 17, Ohio.

√ √ √

Extended payment plans have been announced by the Gisholt Machine Co. to broaden the leasing plan introduced by the company some time ago. The new arrangement provides a program that permits companies to obtain new equipment with an initial down payment of 20 percent and a choice of payment plans ranging from 12 to 48-month periods. A second interesting feature of the plan is that it reverses the normal pattern of interest rate changes and starts with the lowest amount and gradually increases.

research

A grant of $16,500 has been made to Illinois Institute of Technology to finance a three-year study of the economics involved in replacing capital equipment and other equipment policy problems. The fund was set up as a three-year fellowship covered by three annual grants of $5,000 each, by the Ingersoll Foundation of Ingersoll Milling Machine Co. The work, to be carried out through the National Center of Education and Research in Dynamic Equipment Policy, will include analysis of the Ingersoll company's capital equipment replacement policy. Raymond R. Mayer formerly organization and methods analyst with Ford Motor Co. has been named as the first recipient of the fellowship.

√ √ √

First research and development center to be devoted exclusively to service of the process industries in liquid solids separation through filtration has been completed by The Eimco Corp. The research center is equipped to test samples and present pilot plant determinations to industries with filtration problems. Projects currently under way are concerned with more economical use of natural resources, more economical separation of materials and design of new equipment.

√ √ √

Possibly the first plant to house automatic research and experimental activities has been opened by the Sahlin Engineering Co. Automation machinery to be built at the new facility, located in Birmingham, Mich., includes the Sanlin Transfer machines for sheet metal lines.

√ √ √

New research and product development center for Micro Switch division of Minneapolis-Honeywell Regulator

Co. has been opened in Denver, Colo. This center, at 387 Corona St., will supplement research activities conducted at the main office and factory in Freeport, Ill. Wilbert Martin, assistant director of product research and development, is in charge of the Denver facility.

purchases

Lester Engineering Co., designers of injection molding and die casting machinery, has purchased the Phoenix Machine Co. as a private production source. Spokesman indicated the purchase was made in order to increase production and ultimately to reduce cost of equipment through expanded facilities and improved production methods.

√ √ √

Tabor Manufacturing Co. has now become a division of Turbo Machine Co. as result of purchase involving the business name trademark, inventories, patents and licenses. The transaction did not include the remaining assets, principally fixed assets of Tabor, which will be sold at auction.

√ √ √

Completion of the sale of its subsidiary, Michigan Broach Co. has been announced by Shatterproof Glass Corp. The financial group making the purchase was not identified; however, the purchase price was reported to be near $1,000,000. The new organization, which will continue to operate at 4[illegible]35 Cabot Ave., Detroit, is to be known as Michigan Broach Corp.

√ √ √

City Engineering Co., Inc., 3547 Massachusetts Ave., Indianapolis, Ind. now is in production of the line of hardened drill sleeves which they purchased recently from the Sheldrick Mfg. Co.

carbide production

Formation of a company that will manufacture a complete line of cemented tungsten carbide tools and blanks has been announced in Detroit. The firm Valenite Metals Corp., is located at 31100 Stephenson Hwy., Royal Oak, Mich. Already equipment has been installed and pilot runs produced of the materials which will be sold under the trade name "Valenite."

The corporation is headed by Eletor Kotwick, formerly vice-president and secretary of Modern Corp.

√ √ √

Production on a custom basis of precision tungsten carbide castings can be turned out by the Carbide Mfg. Co., Houston, Texas. To emphasize the type of work that can be done because of the close tolerances that can be held through the company's method, it displays such samples of its work as needle valve points for adjustable chokes, slush nozzle inserts for jet-type drilling bits and a six-inch flow bean for oilwell chokes.

expansions

Open house celebration marked the opening of the modern mill-branch warehouse and office for The Carpenter Steel Co. in Dayton, Ohio. New location for the facility is 229 Leo St. It is under the supervision of W. C. Kunkelman, Southeastern district manager.

√ √ √

Norton Co. is increasing its electric furnace capacity by building a new plant in Huntsville, Ala. Completion at a total cost of about $1,250,000 is scheduled by the end of 1955. It will consist of two electric furnace buildings, an office and utility building and a research building.

C... ing **metalworking** and industri... ivity in the New England area has ... Crucible Steel Co. of America to ...ge its special purpose steel wa...e facilities, by 200 per cent sin... 0. The company's newest warehou... $250,000 structure, is located at ... ate St., North Haven, Conn.

√ √ √

P... **have** been announced for construc... of a new plant in LaVerne, Cali... for the Mercast Corp., affiliate of the Atlas Corp. The facilities are expected to be in full operation early in 1955.

√ √ √

A new **$500,000** plant is ready for occupancy by Enamelstrip Corp. at Allentown, Pa. The facility is part of a million-dollar expansion program outlined to meet increased demands for pre-coated metal coil and for the Marvibond vinyl-to-metal laminate coil which Enamelstrip was recently licensed to manufacture by United States Rubber Co.

√ √ √

Work is under way on the major expansion of stainless steel tube pickling facilities for the Pacific Tube Co. in Los Angeles. The $200,000 plant is expected to be in operation sometime in February.

moves

Stocking warehouse and branch office of the J. N. Fauver Co., Inc. which formerly were located in Dayton have been moved to 5562 Montgomery Rd., Cincinnati, Ohio, giving the company a larger merchandising center and broadening the area which this branch can serve.

√ √ √

Cole Carbide Industries is now operating in its new modern plant on Ryan Rd., Royal Oak, Mich. which was designed and laid out exclusively for building carbide cutting tools.

√ √ √

New York offices of Pratt & Whitney, Div. of Niles-Bement-Pond Co. have been relocated at 42-19 Main St., Flushing 55, L. I., N. Y.

√ √ √

Dayton engineering staff of The Monarch Machine Tool Co. has moved into new, larger facilities just completed at 346 Leo St.

good reading

Dynamics in Machines *by F. R. Erskine Crossley. Published by The Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price $7. 446 pp.*

This textbook is suited for the introductory vibration course and for intermediate courses and dynamics. It offers junior and senior mechanical engineering students a logical sequel to introductory courses and statics, dynamics, kinematics, and calculus. It covers all important aspects of engineering dynamics applied to machines.

Adhesive Bonding of Metals *by George Epstein. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Price $2.95. 218 pp.*

It is the purpose of this book to give sufficient details so that an engineer, faced with the problem of joining two metals, will be able to determine if an adhesive-bonded joint would be advantageous, the type of adhesive to select, how to employ the adhesive, and how to design the joint for optimum performance. In particular, adhesives are considered which are most generally employed with metals.

A fairly comprehensive discussion is given of the chemistry and formulation of adhesives, especially in relation to the properties of the cured adhesive bonds. Sandwich construction is considered in some detail, especially with reference to the roles played by adhesives.

Material Handling, No. 4. *Published by the Material Handling Institute, Inc., 813 Clark Bldg., Pittsburgh 22, Pa. Price 50 cents. 10 pp.*

This manual is designed to give material handling engineers a guidebook and to provide teachers and students with better instruction and study material. The relation of material handling to the engineering function, the operating function and the training function is given in detail.

PORCELAIN ENAMELS AND CERAMIC COATINGS AS ENGINEERING MATERIALS, No. [illegible] *Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price $2.50. [illegible] pp.*

This bound collection of symposium papers and discussions covers many phases of porcelain enamel and ceramic coatings from an engineer's standpoint.

Among the topics covered with relation to porcelain and ceramic coatings are: steel, weathering, acid resistance, application to aircraft power plants and surface abrasion.

FACTS ABOUT STAMPINGS. *Published by Pressed Metal Institute, 2860 E. 130th St., Cleveland 20, Ohio. Price 50 cents. 32 pp.*

This book is offered as an aid to those who are faced with problems in the designing and redesigning of parts for metal stamping products.

Included in the subjects covered are: holes, flanges, radii, layout, notches and slots, gage inspection, tolerances, steel gages, dimensions, check list for prints, press section, definitions and suggested terms and conditions of sale for the industry.

FIBERGLAS REINFORCED PLASTICS *by Ralph H. Sonneborn. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Price $4.50. 240 pp.*

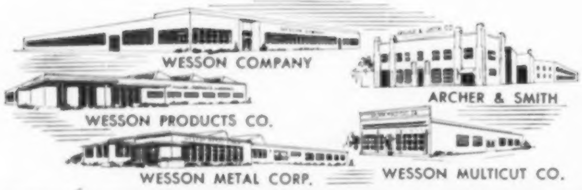
Written for both design engineers and executives in the materials industry, this book covers in detail the resins and glass reinforcements used in reinforced plastics, molding techniques, inspection and testing, properties and design considerations.

Among the subjects discussed are: the nature and uses of fiberglas reinforced plastics, manufacturing processes for fiberglas reinforced plastic, secondary operations, inspection and testing, and a glossary of terms as applied to fiberglas reinforced plastics.

QUALITY CONTROL *by Norbert L. Enrick. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $4. 181 pp.*

This manual is written to be practical and usable, with emphasis on clarity of directions and simplicity of methods. Among the subjects discussed are: ready made sampling plans, sample control charts, compressed limit gages, basis of proper specifications, and separate theoretical chapters.

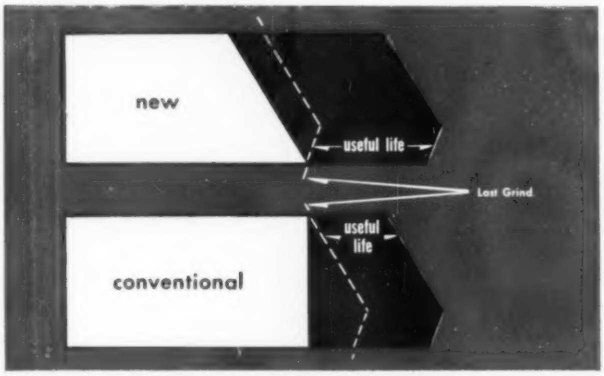
Emphasis is placed on the practical application of quality control and an understanding of the basic methods.



carbide NEWS

Carbide Tip Waste Cut 30%

Wesson milling cutter blade design has base parallel with peripheral cutting edge; permits more regrinds per blade



Reduction in carbide waste is assured by the new milling cutter blade, at top, since base of carbide tip parallels the peripheral cutting edge. Conventional blade is shown below.

A new carbide-tipped milling cutter blade design now incorporated into the Wesson Rigidicut milling cutter line is producing an increase of 30% or more in blade life.

Tipped with Wessonmetal carbides, the new blade permits maximum carbide usage and enables many more regrinds per blade.

The new blade design is compared with old style blades in the sketch at the left. In the new blade, the base of the carbide tip is parallel with the peripheral cutting edge, eliminating waste.

Because of the success of the new design in extensive field application tests, it is now standard in most Rigidicut cutters in the fine pitch and coarse pitch series. Additional economy results since these blades are being made available at no increase in price.

Complete engineering data and price information on the entire Rigidicut milling cutter series is available from Wesson Company, Dept. AD, 1220 Woodward Heights Blvd., Detroit 20, Michigan.

Wesson Metal Now In Top 3

With the official opening recently of a new and modern carbide plant in Lexington, Ky., Wesson Metal Corporation entered the ranks of the three largest carbide manufacturers in this country. A model of scientific design, the new Wessonmetal plant occupies over 40,000 square feet of manufacturing space.

In the new plant, greatly expanded research and development facilities will highlight continued development of new carbide metal-cutting grades. The company's quality control laboratories contain some of the most advanced scientific equipment available.

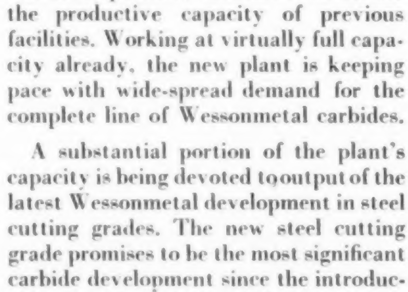
The new plant, which houses some entirely new manufacturing and quality control developments, will more than double the productive capacity of previous facilities. Working at virtually full capacity already, the new plant is keeping pace with wide-spread demand for the complete line of Wessonmetal carbides.

A substantial portion of the plant's capacity is being devoted to output of the latest Wessonmetal development in steel cutting grades. The new steel cutting grade promises to be the most significant carbide development since the introduction of steel cutting carbides.

New Multicut Holder Gets Peak Efficiency From Fischer Lathes

Popularity of the Fischer copying lathe springboarded the development of a special band-type Multicut tool holder. Coupled with the steel band used on all Multicut holders is a new top clamp that assures rigidity of insert when the tool is recessing or going through the outfacing cycle.

Combination of band and clamp permits closer tolerances and finer finishes in the complete range of Fischer lathe applications. Finish turning is eliminated in many operations. The holder uses standard Wessonmetal D-55 inserts.



Closer tolerances and finer finishes result from band and clamp used in Multicut holder.

CARBIDE DATA

Additional information and specifications available:

- ☐ 121 page catalog covering complete standard and special Rigidicut milling cutter and blade line.
- ☐ Specification-Data Sheet on special Multicut holder.

Get data by writing to:
WESSON COMPANY, Dept. AD,
1220 Woodward Heights Blvd.
Detroit 20, Michigan

tools Wesson
carbide Wessonmetal

technical digests

How Automatic?

economic and natural limits will determine extent of automation of many operations

By W. G. Johnson

Manager, Research and Engineering
Norton Co.
Worcester, Mass.

How automatic should a modern machine tool be ? Can designers go on making machinery more and more self-sufficient or is there a point beyond which the human factor should be allowed to count for something? In grinding, an operator judges work speed by observation. Rate of infeed, establishing size and finish, and truing or dressing of a wheel depend upon operator judgement and his art or skill in handling many variables.

It is open to question whether it is economically advisable to attempt to replace all of the skills of the human operator by mechanisms. Beyond a certain point of automaticity the objectives can be gained only at the expense of added complications which may not be worth the cost.

Machine design has grown with a continuous effort to provide mechanisms which would minimize the effort and responsibility of the man. Hydraulic footstocks, power wheel head traverse, automatic coolant shutoff, grinding gages, selectable feed controls, booster features for mass movements, and built-in truing devices were designs primarily to help the operator conserve strength and provide convenient refinements for control. Thus, development of a semi-automatic grinding machine, *Fig.* 1, for example, has now been attained to meet a variety of requirements, though its completely successful operation still depends on the skill of the operator.

A good example of this condition is found in precision cylindrical grinding. Observation will quickly establish what the machine does and what the operator as a human contributes. If the design attempts to do the same things without the operator, many difficult mechanical problems arise including such items as size control, feeding motions, machine controls, slow-down feeds, infeeds and dressing of the grinding wheel. Some of these problems are represented in *Fig.* 2. Such problems have a way of multiplying themselves. For instance, when the truing operation is made automatic, some compensation must be provided for wheel diameter reduction to retain satisfactory work size control, *Fig.* 3. Thus, in transfering skills of an operator to a machine, careful judgement must be used to avoid progressive accumulation of errors. Temperature changes, mechanical tolerances of gears, feed screws, way fits, lubrication variances, diamond wear, etc., must be considered and compensated for. When these various mechanisms are tied together by some form of automatic control, the designer is faced with the attempt to equal the sense of the human operator in the form of ability to feel, see and judge when to make adjustments.

There must be some point at which there is an economic advantage in stopping the design efforts directed toward the completely automatic machine. Each job has its own conditions, however, and there are cases in which it is economical to expend the efforts and cost which result in a machine which has built into it as much of the man as is possible, such as shown in *Fig.* 4. A machine which is automatic requires careful attention to design details which not only keeps it productive, but also keeps it producing acceptable first quality work with a minimum of down time for expensive maintenance. The creation of such a

Fig. 1. Work loading mechanism and cycle-operating control on semiautomatic machine for grinding valve plugs.

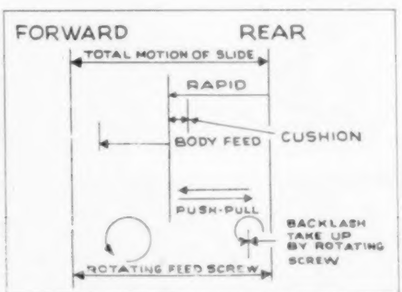


Fig. 2. Schematic diagram of grinding wheel feed motion.

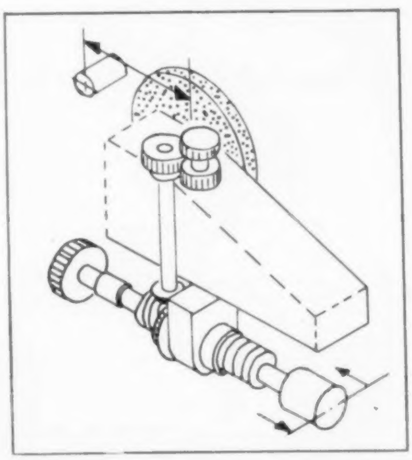


Fig. 3. Mechanism for compensating for wheel-diameter reduction.

machine serves to underscore the true importance of the marvelous machine known as man. He is such a wonderfully perfect engineered composition of matter, motion, power and control such

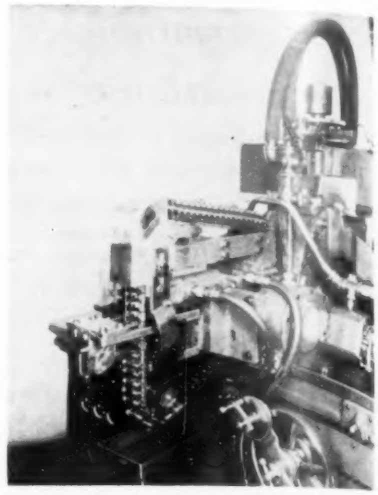


Fig. 4. Chain-type floating fixture with work loaded in position on automatic grinding machine.

that to replace him by mechanical design within a machine requires a considerable investment in design and mechanism.

Progressive transfer of skills from operator to machine has been under way over the past years and today some of the possibilities resulting are being experienced in modern industry as the automatic machine or automation.

From a paper No. 54-F-7 "Progressive Transfer of Skills from Operator to Machine" given at the Machine Design and Production Engineering meeting of the ASME, Sept. 1954.

▼ ▼ ▼

Russian vs American Engineers

by M. H. Trytten

Dir. Ofc. Scientific Personnel

Nat'l Research Council

America is rapidly falling behind Russia in the race to produce engineers. It seems probable that the total number of trained engineers in Russia today is closely comparable to the number in the United States. To accomplish this, the Russians have increased the number of engineering graduates from 29,000 in 1948 to more than 50,000 in 1954. In contrast, the United States graduated 19,000 engineers in 1954.

The number of higher educational institutions in Russia increased from about [illegible] in 1939 to about 900 in 1952. Enrollment in these institutions grew to 916,000, an increase of 50 percent over the same period. Even more significant, however, is the fact that enrollment for professional training has grown sixfold in the past 25 years, while training of supporting semi-professional personnel has grown sevenfold.

Engineering training lasts five to five and a half years and is based on about 5,000 hours of lectures, classroom and laboratory instruction, attendance at which is mandatory.

Soviet professional training begins early in the secondary schools where emphasis is strongly on science and mathematics for all students. There are no electives and about 40 percent of the curriculum is devoted during the three years to science and mathematics.

Meanwhile perhaps only 20 percent of American high-school graduates have had general science courses and less have had physics and chemistry.

More Russian Technicians

One of the major differences between the American and Russian educational systems rests in the area of training below professional levels. The Russians have some 3500 technikums, or technical institutes, offering three and four-year curricula. These schools have over 1,000,000 students and are now turning out 350,000 graduates annually, of which 50,000 are technicians.

Local control of education, which may have been our greatest strength in the past, may become a source of weakness in the future unless greater awareness of the importance of education is developed at the local level.

Russia has apparently solved the vexing problem of the role of the technical specialist in a very direct manner. However, America should not abandon principles of liberal and broad general education.

To meet the challenge, improving the teaching of science at the high school level; expanding the training of scientists and engineers; and the adoption of a consistent policy for the preservation of professional manpower, especially engineering and scientific personnel are needed.

The paper is an outgrowth of nearly two years of research in conjunction with the Russian Research Institute at Harvard University.

From a paper given before the 1954 fall meeting of the ASME, Milwaukee, Wis.

technical digests

Grinding Titanium

by C. T. Yang
Assistant Professor
and
Professor M. C. Shaw
Dept. of Mech. Engrg.
Mass. Inst. of Technology

When titanium is ground under conventional conditions the rate of wheel wear is abnormally high and the finish produced is poor. Improvement in surface finish accompanies a decrease in wheel wear rate. A study of the influence of a wide variety of operating and grinding wheel variables, *Figs.* 1 and 2, reveals the most important quantities to be grinding wheel speed, type of abrasive, and grinding fluid. When

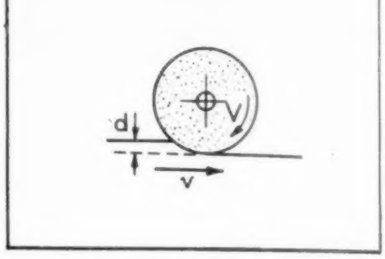


Fig. 1. Surface grinding diagram.

a wheel speed of 1500 to 2000 fpm is used with a suitable fluid and a white aluminum-oxide wheel of conventional hardness, grain size and bonding, greatly improved results are obtained.

The amount of welding or bonding that occurs between a titanium alloy and a grinding wheel will be influenced by those quantities that are of importance in all chemical reactions; namely, temperature, time, concentration of reactants and pressure.

In grinding titanium the chip depth of cut (t) should be made unusually large. This requirement is satisfied automatically when the wheel speed is decreased from the conventional 6000 fpm to about 2000 fpm and other op-

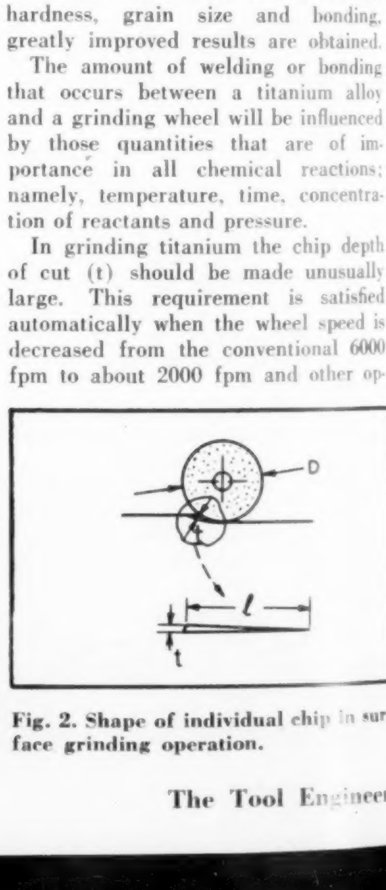


Fig. 2. Shape of individual chip in surface grinding operation.

erating variables are maintained at conventional values for steel.

Thus in those operations in which the workpiece is fed laterally across the wheel so that the metal has an opportunity to cool between cuts (as in surface, cylindrical, centerless and internal grinding) it is advantageous to lower the wheel speed to the vicinity of 2000 fpm. The other operating variables in surface grinding are in the conventional range, and the following values are recommended:

1. Table speed, 300 ipm
2. Depth of cut, 0.001 in.
3. Axial feed, 0.05 ipp

For this type of grinding the white types of aluminum oxide which contain numerous small flaws are best, the optimum grit size being about 60. A medium-hard wheel (about L grade) with medium spacing should be used. Wheels with vitrified bond have been satisfactory. A wheel having the designation AA-60-L8-V or the equivalent will give good results.

Water-base cutting fluids containing ionizable salts of the alkali and heavy metals give improved grinding performance. Under these conditions wheel life will be equivalent to that used in grinding hard steel and surface finish will be as good as can be obtained in grinding steels under conventional conditions.

While it may appear on first thought that a decrease of cutting speed might result in a decreased production rate or an increase in surface roughness, this is not true. The production rate is independent of wheel speed and depends only on the table speed and axial feed which are still maintained in the conventional range. While a decrease in wheel speed will cause the chip depth of cut to increase, the surface finish does not vary with this quantity alone but also varies with the size of the built-up edge that results from welding between chip and tool, *Fig.* 3. In fact, the influennce of the decreased build-up with decreased wheel speed causes a greater effect upon surface finish than the accompanying increase in chip depth of cut.

In those processes in which the wheel grinds continuously in one region of the workpiece such as in the snagging and cutoff operations, higher cutting speeds are called for. For example, good results were obtained in the cutoff operation with a silicon-carbide wheel of 60-grain size when operating at 7000 fpm using a water solution of sodium nitrite.

While titanium alloys do not present an undue industrial hazard it is advisable to exercise good housekeeping practice and not allow the chips to accumulate on or about the machines. The use of a water-base cutting fluid is recommended as another safeguard against fire in addition to offering the best means for discouraging wheel wear and promoting improved surface finish.

From a paper (54-SA-57) presented at the 1954 semiannual meeting of the ASME.

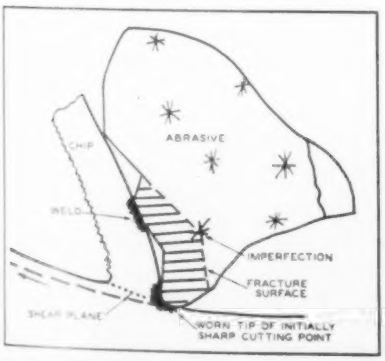


Fig. 3. Manner in which portions of abrasive grains fracture and leave system as a result of adhesion between chip and abrasive grain.

technical digests

Producing Large Plastic Moldings

by J. E. Johnston
Vice President

Chicago Molded Products Corp.

What makes a good large molding? Success in large moldings depends more than anything else on sound engineering. Many new applications that "couldn't be done" were produced with sound engineering.

Design of the part is important but only part of the story. The tool design must be correct to insure proper density of the material and to eliminate "runaway" shrinkage, *Fig.* 1. Improper design of the mold could develop into a shrinkage of more than ¼ inch over and above the regular shrinkage. It could easily be so bad that the two parts could not be assembled.

Fig. 1. Die for large thermosetting plastic molding. Mirror-like surface finish is required for high quality finished product.

In planning for production of large TV cabinets, they had to be designed with a definite consideration of the molding problems involved. Engineers of the TV industry had to recognize this or else the project could not be followed through to a successful conclusion and they were so told. Because of this important step, the TV cabinet has been highly successful and opens avenues to other fields of similar size. The following pointers in production design resulted from this experience:

1. Design to avoid warpage. Avoid square, box-like shapes. Provide crowned top and curved sides for added resistance to warpage as well as to increase strength. This will also increase production and eventually reduce cost.
2. Provide for adequate wall thickness to give necessary strength.
3. Place ribs in corners and not on flat surfaces. External finish will then be far superior.
4. Subject the product to breakage tests. Make sure that it will stand up in the type of service for which it is intended.
5. Design for interchangeable cabinet fronts to cut down tooling costs for next year's model.
6. Incorporate the picture tube mask in the molded part to eliminate additional assembly costs.

Four hundred cabinets can be produced from single cavity molds in a twenty-four hour day. Larger presses are available, faster flowing materials are being produced, steel manufacturers have studied the problem and are coping with it.

From a paper presented at the 1954 Canadian SPI annual conference.

▼ ▼ ▼

Control Planning and Methods

by Charles D. Cox

San Francisco Ordnance Dist.
Ordnance Corps
Dept. of the Army

Any management, to achieve the most efficient and effective production commensurate with end cost, must plan its total operation to include complete integration of all operations within the manufacturing processes.

This includes a good organization, good communication within this organization, good operating equipment, good inspection equipment, and adequate personnel to coordinate and correlate and control the established procedures, actions, and methods of the operation. Even with good planning many difficulties will occur. If the planning is poor, it is possible that an item will never be produced in the desired quantity and that its cost will be exorbitant. Many times, difficulties are not obvious without analysis. Therefore, it is emphasized that an analytical group should be established and given access to any and all reports or actions that affect any operation within the manufacturing process.

Diagrammatic flow charts have been helpful for planning on recent ordnance contracts, in which specific inspection clauses regarding preplanning have been inserted. The layout is planned

BECAUSE *Lusol* IS DIFFERENT... WE DARE SUGGEST A SHOP-WIDE TEST!

Prove Lusol—not in just a single machine—but in a lathe, boring mill, grinder, milling machine and drill

THE DIFFERENCE—Unlike ordinary coolants, Lusol is an oil-free, all-chemical concentrate to which you add water to suit the machining operation. Water, the best coolant known, is made wetter so that it gets to the tool point and carries off heat faster. With Lusol there is no rusting, no skin irritation, no smoking to foul shop atmospheres.

YOUR BENEFITS—Superior heat dissipation means that your present equipment can be worked harder, yet your men find things easier—higher speeds and feeds, with less downtime for sharpening tools, finer finishes and closer tolerances. Improved working conditions result in better morale among your employees.

These benefits become shop-wide as your workmen recognize Lusol's advantages and ask for it in their machines.

AN OFFER—Prove to your own satisfaction—in your own plant, in your own machines—that Lusol will do all we say it does. Our field engineers will help you clean out the machines marked for the test and install Lusol in proper concentrations. Past experience in hundreds of metal working machines indicates you'll do jobs faster and better.

TO GET THIS TEST WORKING, MAIL THIS COUPON

We'll have a Lusol field engineer call and arrange to run the test in your own plant.

F. E. ANDERSON OIL CO., INC.
PORTLAND, CONNECTICUT

F. E. Anderson Oil Co., Inc., Box 213, Portland, Connecticut

☐ Send me the leaflet, "Case Histories of Lusol at Work" and any other data.

Name_______________ Title_______________

Company_______________

Address_______________

☐ Have your man call to discuss arrangements for installing Lusol All-Chemical Coolant in the machines selected for this test. ( )

by using diagrammatic flow charts complete with inspection stations, production equipment placed for minimum handling, methods of banking material in process, tooling needs, cycle times, etc.

Operational procedures are drafted so that personnel can be trained and directed with a minimum expenditure of time. Through such planning, many situations can be anticipated before they become problems. It is not feasible for key personnel to plan a complete operation without inspection personnel being represented to determine and plan the equipment necessary to control the production equipment, the placement of inspection stations, and the collection of data needed for control.

Control of Tooling

Tooling is one of the points at which control is most critical. It is of primary importance that good tooling be provided for in the original planning. "Good tooling" applies to design of dies, fixtures and special equipment or instruments which will give extended service with a minimum of maintenance or attention. In equipment planning, the greatest factor which will affect production, other than the procurement of machine tools in good condition, is tool maintenance and control.

There are numerous ways of recording information in the receiving or production departments. However, for maximum control, it should be re[illegible] by characteristic, such as ha[illegible] ductility, embrittlement, dimensional control, etc., on critical dimensions or characteristics. Use of variables sampling, which is normally used in connection with destructive testing, and dimensional control will give the manufacturer maximum assurance from minimum samples.

The use of attributes inspection (that is, determining if a part is good or bad with no degree involved) must not be ignored, however. There are a great number of uses for this type of inspection and, if the characteristic being checked is not of a critical nature, it is recommended that attributes inspection be utilized, and that records be maintained and process averages be calculated in terms of percent defective, since this process normally gives control with a minimum expenditure for precision gages.

Data should continuously be fed into the analytical-statistical group in order to determine any trends toward an out-of-control condition. These data can be used as a basis for redesign, as additional data on materials, as a record

on variation of materials, etc., in order that production and design may be continuously improved. This improvement should lower costs because of reduced over-all scrap rates, reduced machine down time and manual handling, less rework and correction or improvement of contracted materials.

From a paper given at the 1954 Automatic Production Symposium sponsored by Stanford Research Institute & USAF, San Francisco.

▼ ▼ ▼

Characteristics of Metal-Arc Welds

by Julius Heuschkel
Westinghouse Electric Corp.

Availability of testing equipment for the evaluation of complete tensile characteristics of metals at temperatures across the full range of general interest has provided a new insight into the properties of carbon steel weld metals in common usage. Nitrogen content of the weld deposit is shown to have a pronounced effect upon the weld ductility, particularly at extremely low temperatures. This element is also shown to be responsible for the nuclei of the common "fisheyes" in weld fractures under those conditions involving higher availability of gaseous nitrogen.

At temperatures below —70 F the yield point stress becomes higher ... of the nominal ultimate tensile strength, when selection loads from the load-deflection curves in the conventional manner. The sharp yield point characteristic of the stress-strain curves at low temperatures gradually diminishes with increased temperatures and disappears entirely at about 500 F. Above that temperature there is no sharp yield point. Pronounced strain-aging is shown to occur at around 300 F, even for welds containing as little as 0.019 percent nitrogen.

Welds containing 0.043 percent N achieved full brittleness at —300 F, even when using unnotched specimen.

Stress relief annealing at 1200 F failed to improve the ductility of these high nitrogen weld deposits at —300 F and therefore such brittleness is not due to hydrogen. Low (0.019 percent) nitrogen content welds retained nearly full ductility down to —300 F, although strength-elongation ratio was decreasing.

Brittle fracture was shown to occur when the yield stress became equal to the true stress at rupture.

From a paper presented at the second annual welding show and 1954 meeting of the American Welding Society.

by using diagrammatic flow charts complete with inspection stations, production equipment placed for minimum handling, methods of banking material in process, tooling needs, cycle times, etc.

Operational procedures are drafted so that personnel can be trained and directed with a minimum expenditure of time. Through such planning, many situations can be anticipated before they become problems. It is not feasible for key personnel to plan a complete operation without inspection personnel being represented to determine and plan the equipment necessary to

PRIN

MISS

The use of attributes inspection (that is, determining if a part is good or bad with no degree involved) must not be ignored, however. There are a great number of uses for this type of inspection and, if the characteristic being checked is not of a critical nature, it is recommended that attributes inspection be utilized, and that records be maintained and process averages be calculated in terms of percent defective, since this process normally gives control with a minimum expenditure for precision gages.

Data should continuously be fed into the analytical-statistical group in order to determine any trends toward an out-of-control condition. These data can be used as a basis for redesign, as additional data on materials, as a record

on variat n of materials, etc., in order that production and design may be continuously improved. This improvement should lower costs because of reduced over-all scrap rates, reduced machine down time and manual handling, less rew and correction or improvement of contracted materials.

From a paper given at the 1954 Automatic Production Symposium sponsored by Stanford Research Institute & USAF, San Francisco,

▼ ▼ ▼

Characteristics of Metal-

NT

SING

sharp yield point. Pronounced strain-aging is shown to occur at around 300 F. even for welds containing as little as 0.019 percent nitrogen.

Welds containing 0.043 percent N achieved full brittleness at —300 F. even when using unnotched specimen.

Stress relief annealing at 1200 F failed to improve the ductility of these high nitrogen weld deposits at —300 F and therefore such brittleness is not due to hydrogen. Low (0.019 percent) nitrogen content welds retained nearly full ductility down to —300 F, although strength-elongation ratio was decreasing.

Brittle fracture was shown to occur when the yield stress became equal to the true stress at rupture.

From a paper presented at the second annual welding show and 1954 meeting of the American Welding Society.

How to Control and Prevent Corrosion

by L. R. Honnaker

Supervisor, Engineering Consultants
Engineering Department
E. I. duPont de Nemours & Co., Inc.
Wilmington, Del.

Direct cost of corrosion to American industry in several billion dollars annually. An even greater sum of money may be involved in the hidden cost of corrosion. In many instances the value of lost production time incidental with equipment repairs or replacements is greater than the maintenance costs. Today, manufacturing steps are highly integrated and techniques have largely changed from batch to continuous type operations. This means that practically none of the equipment can be out of service for repairs or replacement without seriously curtailing production. Corrosion control and prevention warrants serious attention by management and all others responsible for the building and maintenance of the plants.

There are at least fifteen forms of corrosion of metals, most being electrochemical in nature. Their characteristics are well-known, they are generally easily recognized and information regarding corrective measures or resistant materials is available in technical literature and from other sources.

Forms of corrosive attack on metals that they overlap and may not always be well defined. Many nonmetallic materials are available today for use in combatting corrosion.

Metallic contamination has become an important consideration, and in some instances a limitation, in the use of metals for equipment for processing or handling synthetic textile fibers, pharmaceuticals, and many other products where quality is lowered by such contamination. The use of nonmetallic materials, and in particular the plastics and elastomers, has proven attractive for avoiding metallic contamination as well as corrosion. The use of the latter materials is limited to relatively low pressures and service temperatures, 150-250 F, depending upon material and chemical exposure involved. They are gaining wide acceptance and use in spite of such temperature limitations.

Protective coating is dependent upon three main fundamentals; namely, proper surface preparation, proper coating selection and proper applica-

tion. A compromise in any one of the three will seriously jeopardize chances of obtaining a good protective coating job. Application is generally considered to be the most important. The surface preparation can be excellent and the coating film adequately resistant to conditions, but if it is not applied properly, premature failure will occur. The main problem in application is to obtain freedom from pinholes and holidays in the coating. The best way to assure good coverage over surface roughness, sharp edges, and corners is to apply multiple coats or passes to a dry film thickness of at least three times the profile depth of the surface roughness. Coatings are sprayed on to about 1/8-inch and are tested with spark tester to detect pinholes and holidays.

It is unwise and generally uneconomical to try to use steel equipment coated with chemically resistant coatings for handling chemicals that are quite corrosive to steel.

Job of Corrosion Engineer

The answer to industrial corrosion problems is to assign personnel to corrosion engineering work. They should acquire a good background in the knowledge of corrosion. This includes a knowledge of the corrosive characteristics of chemicals as well as the corrosion resisting characteristics of materials. They should become familiar with the physical and mechanical properties of materials of construction, the physical properties and characteristics of the chemical materials to be handled, information on availability and cost of materials of construction and fabrication techniques and limitations.

A corrosion engineer should investigate cases of failure on high maintenance items and arrive at a decision to effect an improvement. This may involve an experimental program or changes in design or fabrication procedure and not necessarily materials of construction. He should set up specification covering materials, procedures, heat treatment, etc. for new or repaired equipment. He should make inspections of new equipment to see that specifications have been met and existing equipment to see that corrosion difficulties are not developing. He should help establish improved maintenance methods and preventive maintenance programs. Records should be maintained for future reference and standards should be set up for spare parts and materials.

From a paper presented at the 1954 Plant Maintenance & Engineering Show.

 FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-203

How Much Automation for You?

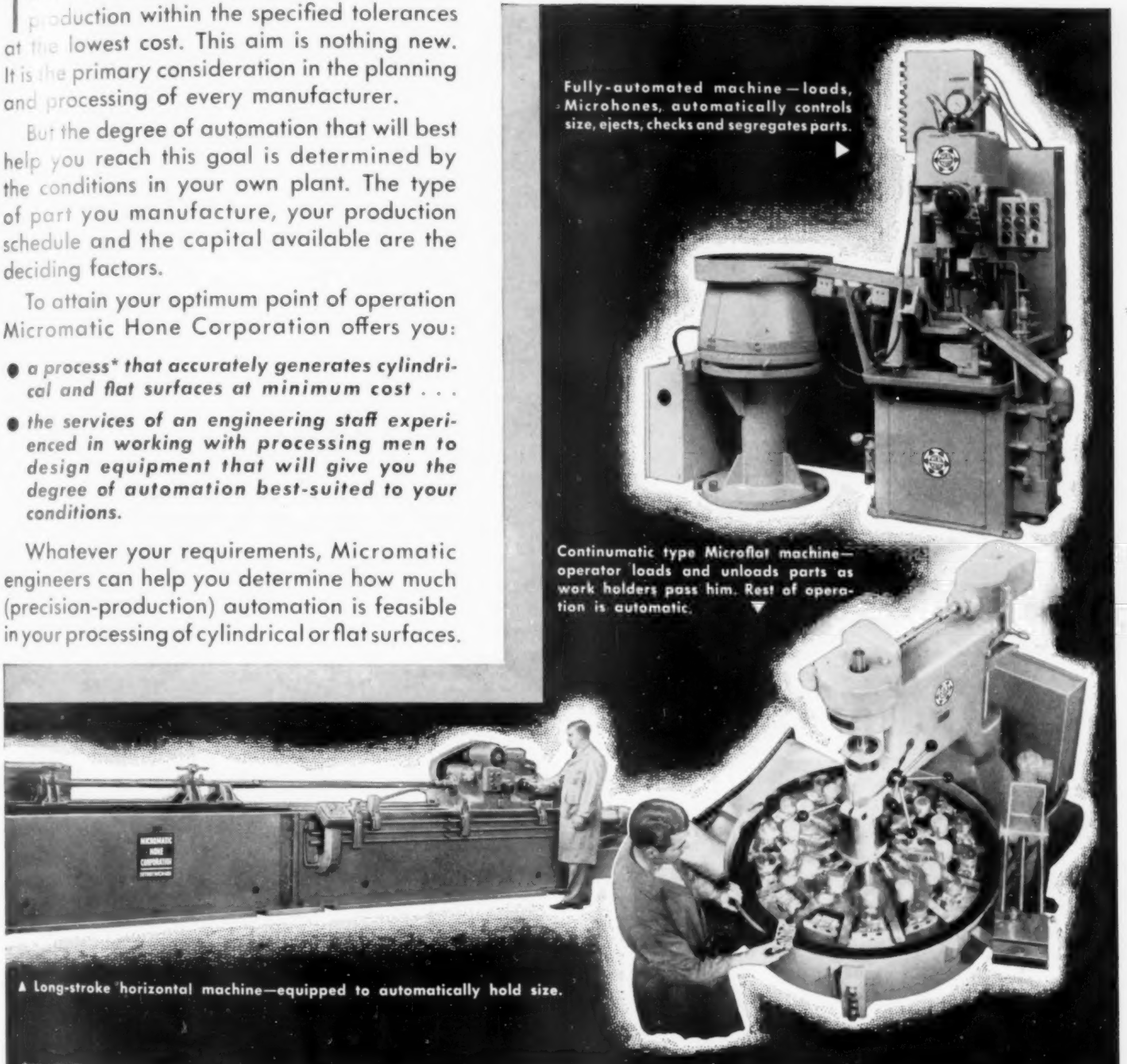
THE AIM of automation is to obtain maximum production within the specified tolerances at the lowest cost. This aim is nothing new. It is the primary consideration in the planning and processing of every manufacturer.

But the degree of automation that will best help you reach this goal is determined by the conditions in your own plant. The type of part you manufacture, your production schedule and the capital available are the deciding factors.

To attain your optimum point of operation Micromatic Hone Corporation offers you:

- *a process* that accurately generates cylindrical and flat surfaces at minimum cost . . .*
- *the services of an engineering staff experienced in working with processing men to design equipment that will give you the degree of automation best-suited to your conditions.*

Whatever your requirements, Micromatic engineers can help you determine how much (precision-production) automation is feasible in your processing of cylindrical or flat surfaces.



Fully-automated machine—loads, Microhones, automatically controls size, ejects, checks and segregates parts. ▶

Continumatic type Microflat machine—operator loads and unloads parts as work holders pass him. Rest of operation is automatic. ▼

▲ Long-stroke horizontal machine—equipped to automatically hold size.

*MICROHONING = STOCK REMOVAL + GEOMETRY + SIZE CONTROL + SURFACE FINISH.

For more information write for general catalog and CROSS-HATCH Vol. 6

1929 • 1954 PRECISION PRODUCTION THROUGH MICROHONING 25TH YEAR OF DEVELOPMENT MICRO MATIC

MICROMATIC HONE CORPORATION

8100 SCHOOLCRAFT AVE., DETROIT 38, MICHIGAN

MICROMATIC HONE CORP. MICRO-MOLD MFG. DIV. Boston Post Road Guilford, Connecticut	MICROMATIC HONE CORP. 2205 Lee Street Evanston, Illinois	MICROMATIC HONE CORP. 1535 Grande Vista Avenue Los Angeles 23, California	MICROMATIC HONE LTD. 330 Grand River Avenue Brantford, Ontario, Canada	MICROMATIC HONE CORP. MICRO-MOLD MFG. DIV. 231 So. Pendleton Avenue Pendleton, Indiana

REPRESENTATIVES: Allied Northwest Machine Tool Corp., 103 S.W. Front Ave., Portland 4, Oregon • Mason Machine Tool Company, 415 So. Second East, Salt Lake City, Utah • Tidewater Supply Co., Charlotte 4, North Carolina • Perine Machinery & Supply Co., 1921 First Ave., South, Seattle 4, Washington

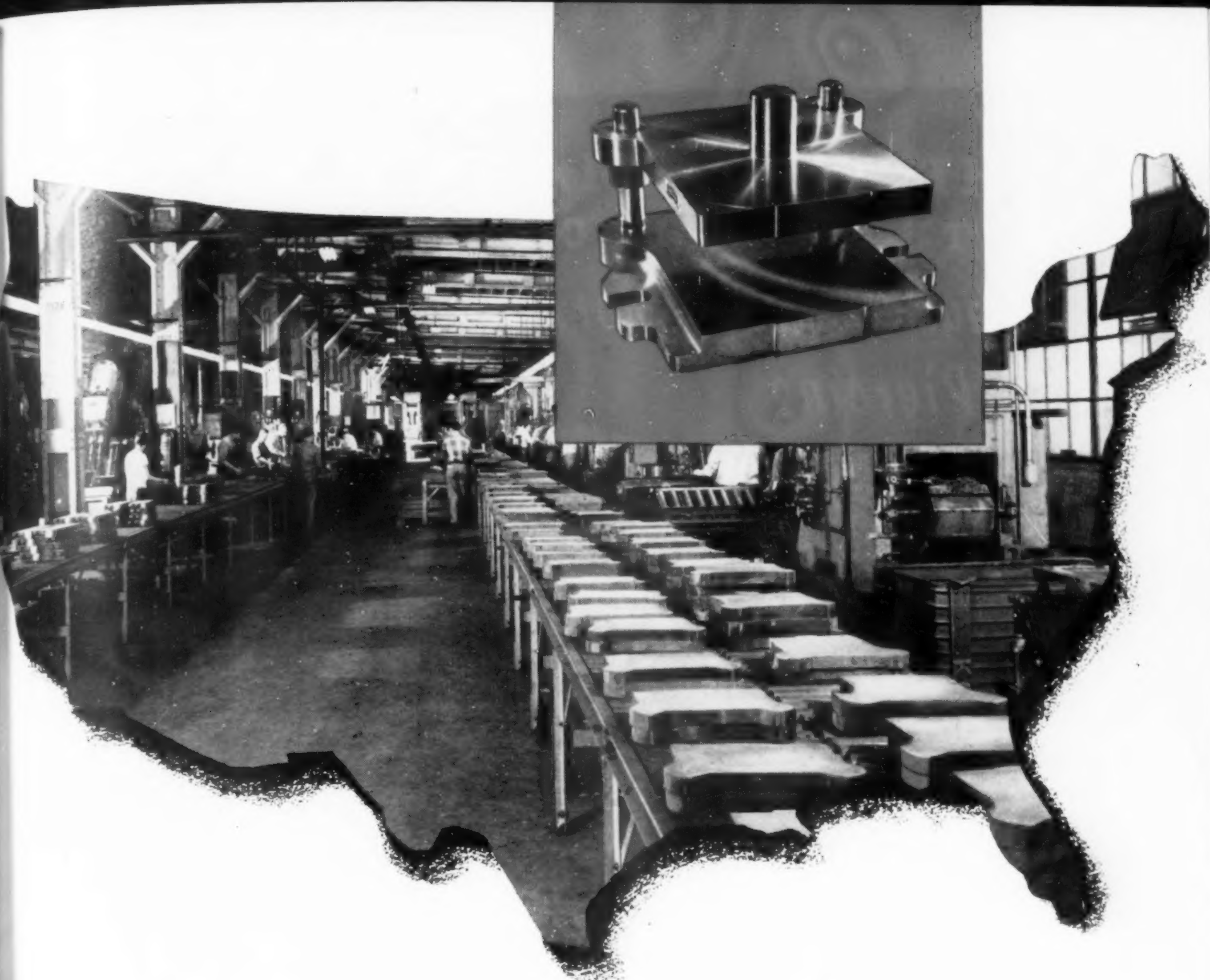
REPRESENTATIVES IN ALL PRINCIPAL COUNTRIES

SUBSIDIARY

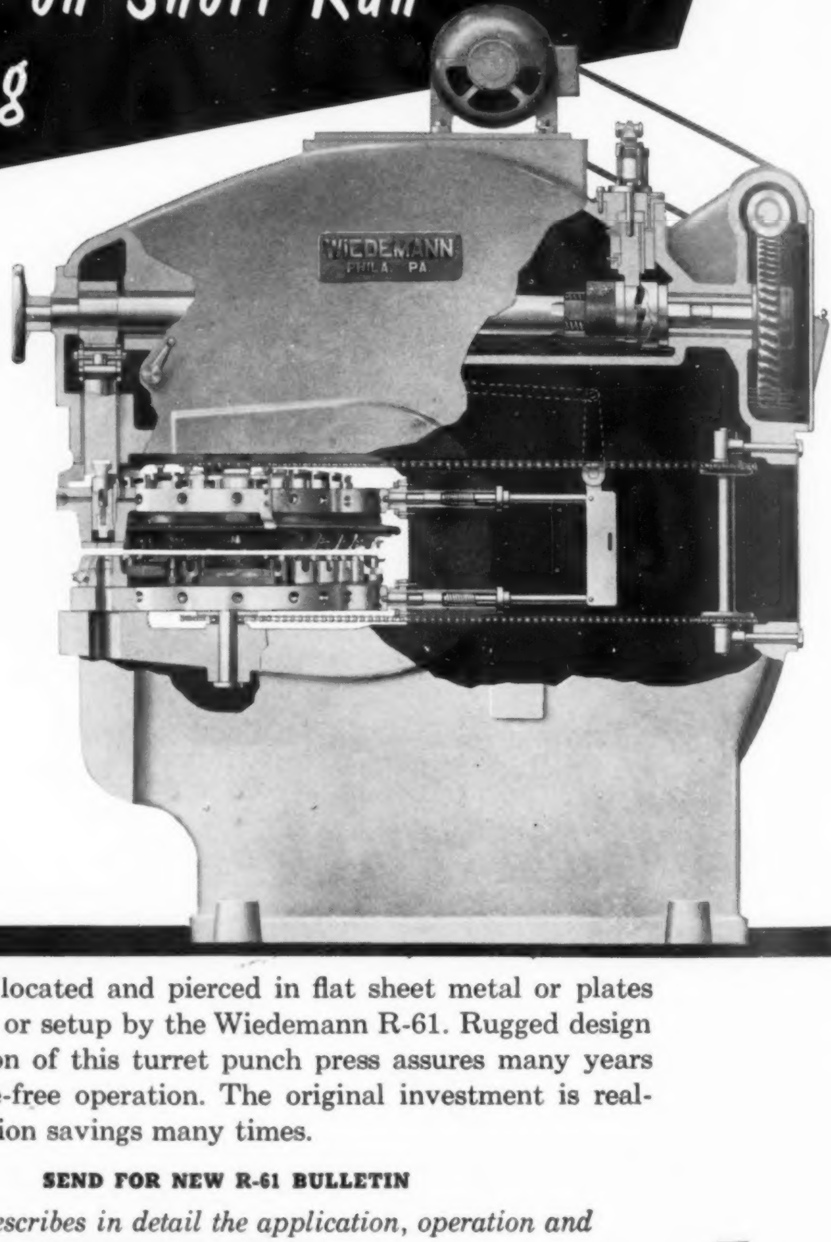
Micro-Precision Inc., 2205 Lee Street, Evanston, Illinois

Hydraulic Controls • Diesel fuel injection equipment

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-205



THE WIEDEMANN R-61
TURRET PUNCH PRESS
Pays Off on Short Run Piercing



- *Eliminates 50% to 90% down time.*
- *Provides unlimited flexibility.*
- *Maintains close tolerances.*
- *Pays off in 2 years or less.*

Holes are located and pierced in flat sheet metal or plates without layout or setup by the Wiedemann R-61. Rugged design and construction of this turret punch press assures many years of maintenance-free operation. The original investment is realized in production savings many times.

SEND FOR NEW R-61 BULLETIN

. . . describes in detail the application, operation and construction of the turret punch press.

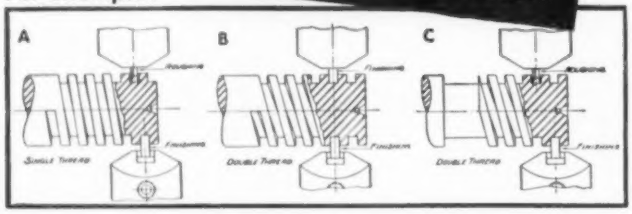
WIEDEMANN MACHINE COMPANY

4245 Wissahickon Avenue, Philadelphia 32, Pa.

How Do Coulter Automatic Threading Lathes SAVE TIME, MONEY, LABOR?

Because they are designed to permit over 25 alternatives for setting up the threading tool to meet specific applications.

For example:



(A) Roughing and finishing Single Square Threads.
(B) Finishing Double Square Threads, simultaneously.
(C) Roughing and finishing Double Square Threads.

The "L1" is the most versatile of any threading Lathe, for the production of Square, Standard and 29° threads, internal or external . . . and it does it faster, better — **AUTOMATICALLY!**

Without obligation, consult our engineers with your specific threading problem. Catalog and machine specifications available upon request.

James Coulter Machine Co.
645 Railroad Ave. Bridgeport 5, Conn.

Machine Tool BUILDERS Since 1896

USE READER SERVICE CARD; INDICATE A-1-210-1

"IN-STOCK" SERVICE ON FAMOUS SPHINX BRAND MICRO-DRILLS

High speed drills for small holes. Sizes from .08 mm (.003") to 1.0 mm (.040") carried in stock, in increments of .01 mm (.0004").

Sphinx brand micro-drills used throughout the world for many years for all fine watch and instrument work.

Send for Bulletin N listing sizes and prices of stock drill sizes and micro-drilling equipment.

These precision drills are available in two styles, flat pivot drills or spiral fluted drills. They are made with concentric oversize shanks. Because of their rigidity they are especially useful in all types of drilling equipment.

LEVIN ® Louis Levin & Son, Inc.
3610 South Broadway · Los Angeles 7, California

USE READER SERVICE CARD, INDICATE A-1-210-2

I'm the W.H.O.* of WHO'S WHO

in the precision screw machine products field
Making the finest
COUPLING BOLTS CAP SCREWS
MILLED STUDS SET SCREWS
. . . our specialty

*Wm. H. Ottemiller Co. YORK, PENNA.
Ottemiller products are sold through Mill Supply Houses and Industrial Distributors.

USE READER SERVICE CARD; INDICATE A-1-210-3

RUST-LICK

WATER SOLUBLE - NON-FLAMMABLE - RUST PREVENTIVE

FOR EFFECTIVE GRINDING OF CARBIDE TOOLS

The use of RUST-LICK "B" and water will increase DIAMOND WHEEL life—eliminate fire hazards, rancidity, dermatitis and rust.

Currently used by leading manufacturers of Carbide Tools.

Write for free sample and brochure.

PRODUCTION SPECIALTIES, INC.
755 BOYLSTON ST., BOSTON 16, MASS.

USE READER SERVICE CARD; INDICATE A-1-210-4

A*IR* engineering at work
REPORT No. 4400.05

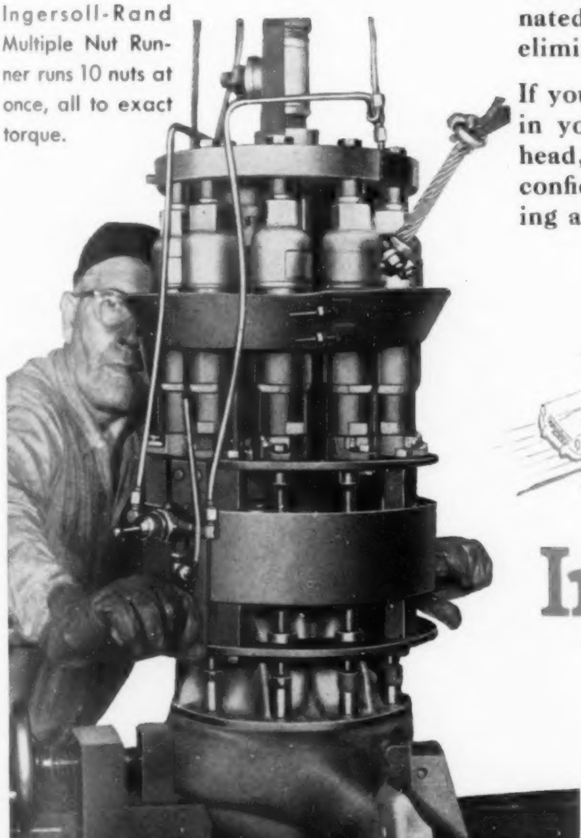
Running Ten Nuts at a Crack...
SAVES $12,000 *a year!*

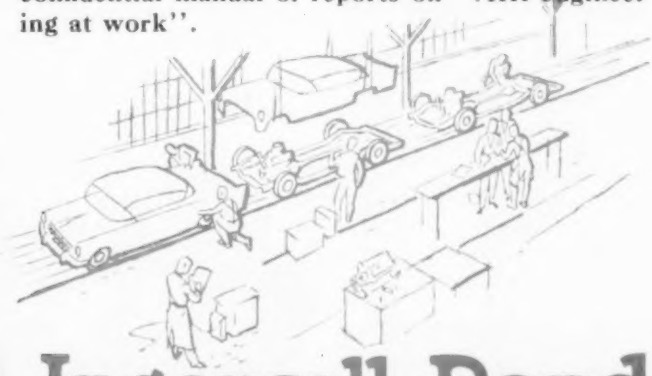
This large auto manufacturer formerly used two ¼ ton presses to position a differential carrier in the rear axle housing. Then the ten ⅜" nuts were run individually. Only experienced operators could control torque so that it met specifications. Naturally the engineers wanted to eliminate the press operation and improve torque control.

AIR engineering by Ingersoll-Rand provided the answer and saved $12,000 a year. A 10-Spindle Multiple Nut Runner is now suspended over the moving conveyor. The differential carrier is hand set on the housing, and dropped to within ⅛" of its final location. The 10-spindle nut runner quickly and accurately draws it into final position as it runs all 10 nuts at once . . . and to the required 50 ft. lbs. torque. The press operation is eliminated, and simultaneous running of the nuts eliminates binding.

If you are in any way responsible for cutting costs in your plant, write us on your company letterhead, and we will arrange for you to see I-R's confidential manual of reports on "AIR engineering at work".

Ingersoll-Rand Multiple Nut Runner runs 10 nuts at once, all to exact torque.





Ingersoll-Rand

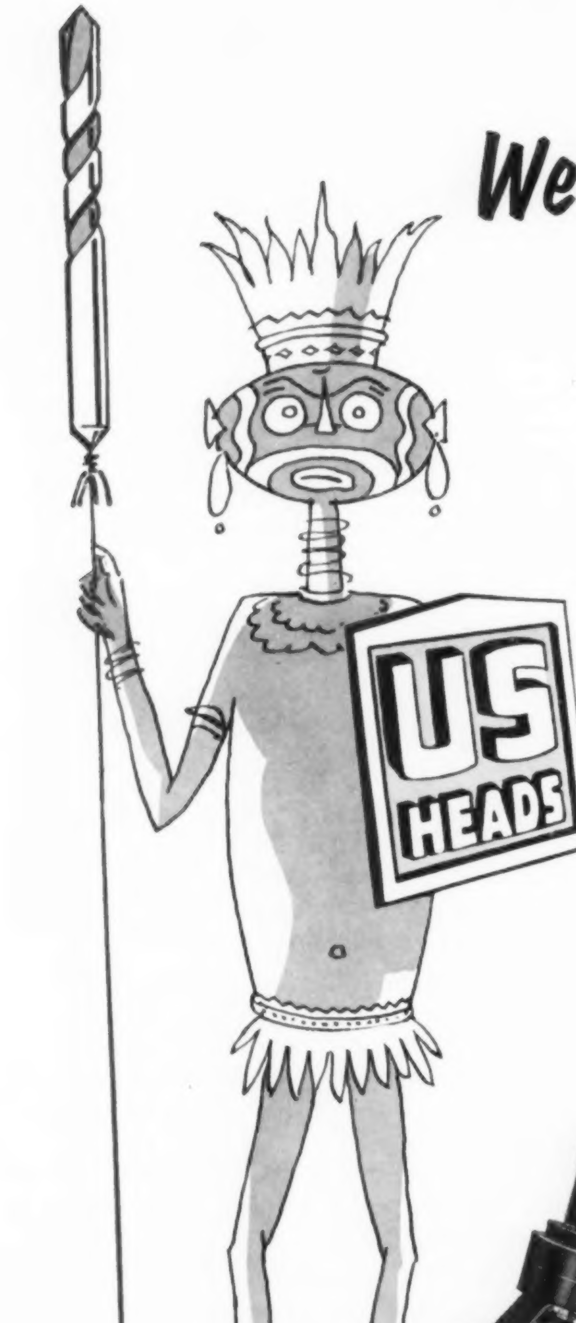
11 Broadway, New York 4, N.Y.

AIR engineering Manual

Don't miss over 100 interesting case history applications of AIR engineering in this confidential manual.

8-147

We're Looking for Head Hunters!....

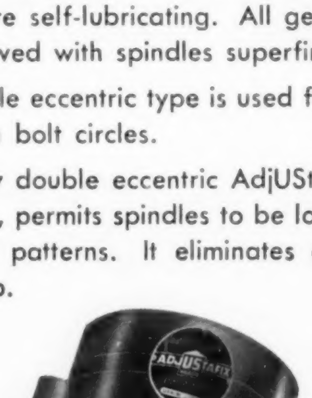


Most machine tool men have long relied upon the "US" Adjustable Multiple Spindle Drill Heads. But we are looking for those who still haven't tried them . . . and who are looking for the best.

With their quick-change universal joint assemblies, they are built for continuous use, with full anti-friction bearing construction for high capacity thrust loads. The universal joint adjustable multiple spindle type is suitable for any sensitive drilling machine. Joints are self-lubricating. All gears are hardened and shaved with spindles superfinished.

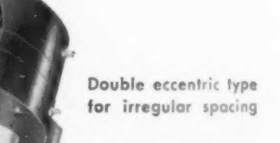
The single eccentric type is used for equally spaced holes on bolt circles.

The new double eccentric AdjUStafix, two to eight spindles, permits spindles to be located in non-symmetrical patterns. It eliminates expensive change in set-up.



Double eccentric type for irregular spacing

Universal joint with slip spindle fixed locating plate



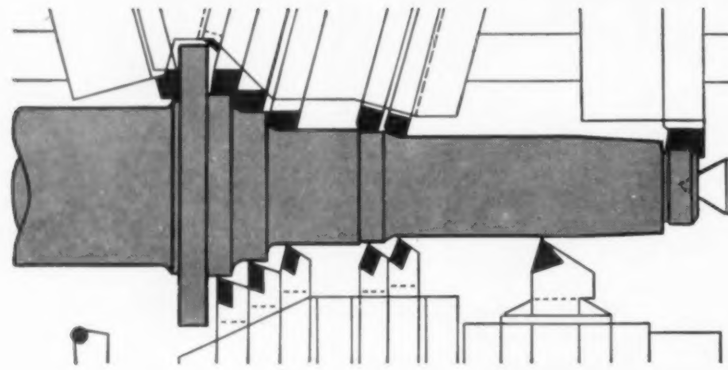
Single eccentric type for equally spaced holes on bolt circle

Write for details on any type of universal joint adjustable head. Ask also about our totally enclosed gear-driven adjustable, fixed center, or individual lead screw tapping heads.

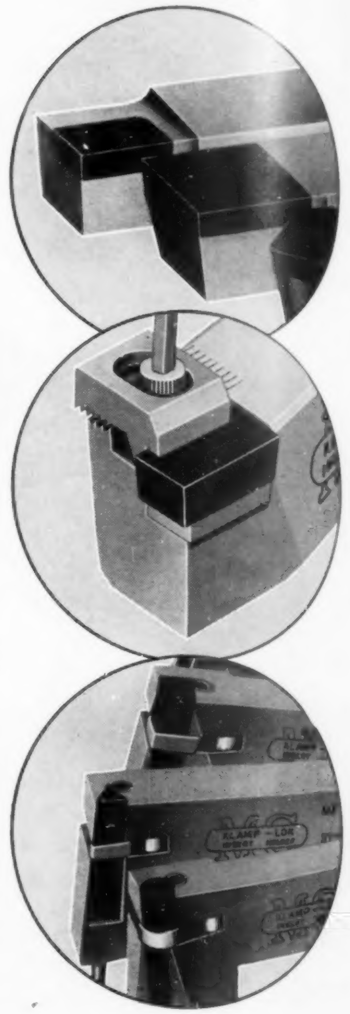
UNITED STATES DRILL HEAD COMPANY

616-618 BURNS STREET • CINCINNATI 4, OHIO

THE TURNING POINT TO HIGHER PROFITS!



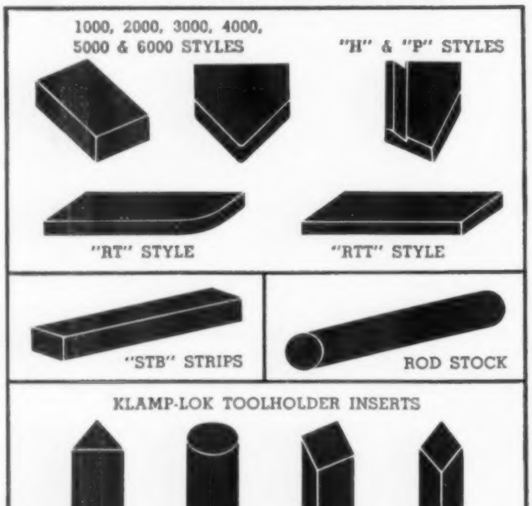
ALL-PURPOSE TALIDE TOOLS



PRODUCTION RATE—UP 25%, TOOL COST—DOWN 40% AT LARGE MID-WEST TRACTOR PLANT

PART	Shaft Steering Clutch, SAE 8654-H Brinell 370.
OPERATION	Rough Straddle Face Flange, turn all diameters, form undercut and base.
MACHINE	16 x 60 Sunstrand Automatic Lathe.
TOOLS	8 Talide-tipped facing, chamfering, radius and form tools Grade S-88. 7 Klamp-Lok Toolholders with round, triangular and parallelogram Talide inserts Grade S-88.
DEPTH OF CUT	9/32" to 7/16"
FEED	.022
S.F.M.	156
RESULTS	Production up 25%—Scrap and rejects down.

A FULL LINE OF TALIDE TIPS IS AVAILABLE IN OVER 1000 SIZES, STYLES, SHAPES AND GRADES—TO MEET EVERY MACHINING REQUIREMENT



NEW IMPROVED CUTTING GRADES

An extensive 2-year research and development program has resulted in a completely new and improved series of Talide Metal grades for all-purpose machining. "Double-carbides" containing tantalum carbide and tungsten carbide have been perfected for cutting cast iron and non-ferrous alloys, and "triple-carbides" containing tantalum carbide, titanium carbide and tungsten carbide for machining steels.

Major improvements have been made in our rigidly controlled vacuum furnace technique. This, along with additional refinements in our process has resulted in the creation of a carbide having a new, unique grain structure possessing harder and tougher properties than previous grades.

Laboratory tests reveal that these new, improved grades have 25% greater strength and rigidity. Extensive field tests have proven that service life per grind is increased up to 50% over previous grades. **Metal Carbides Corporation, Youngstown 7, Ohio.**

Send for new 84-page Catalog No. 55-G.

METAL CARBIDES CORPORATION
MC
TALIDE®
YOUNGSTOWN 7, OHIO

HOT PRESSED AND SINTERED CARBIDES · VACUUM METALS
HEAVY METAL · CERMETS · HIGH TEMPERATURE ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

Ten Million TOCCO*-Hardened Axle Shafts

Battery of TOCCO machines for hardening automotive axle shafts. TOCCO*-hardened shafts show an increase of up to 200% in resistance to torsional fatigue over furnace-hardened shafts made of alloy steel.

Give Super Service to American Motorists

...Save Manufacturers $2,000,000

The application of TOCCO* Induction Heating to the surface hardening of rear axle drive shafts for passenger cars and trucks provides a fine example of how a less expensive manufacturing method often results in the best possible end product.

For instance, TOCCO* Induction Hardening permits the substitution of easier machining carbon steels for expensive alloys, saving from 25¢ to 55¢ per car in material costs alone. Additional savings result from the fact that TOCCO eliminates the need for annealing, tempering and shot peening operations formerly required. Moreover, long hauls to and from the heat-treating department are eliminated because cool, clean TOCCO* fits right in the production line—next to related operations.

If you make parts that require hardening, annealing, brazing, or heating for forging or forming, it can pay you handsome dividends to investigate TOCCO* Induction Heating as a sound method of improving product quality *while reducing costs.*

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today

NEW FREE BULLETIN

THE OHIO CRANKSHAFT CO.
Dept. G-1, Cleveland 1, Ohio

Please send copy of "Typical Results of TOCCO Induction Hardening and Heat Treating."

Name__________

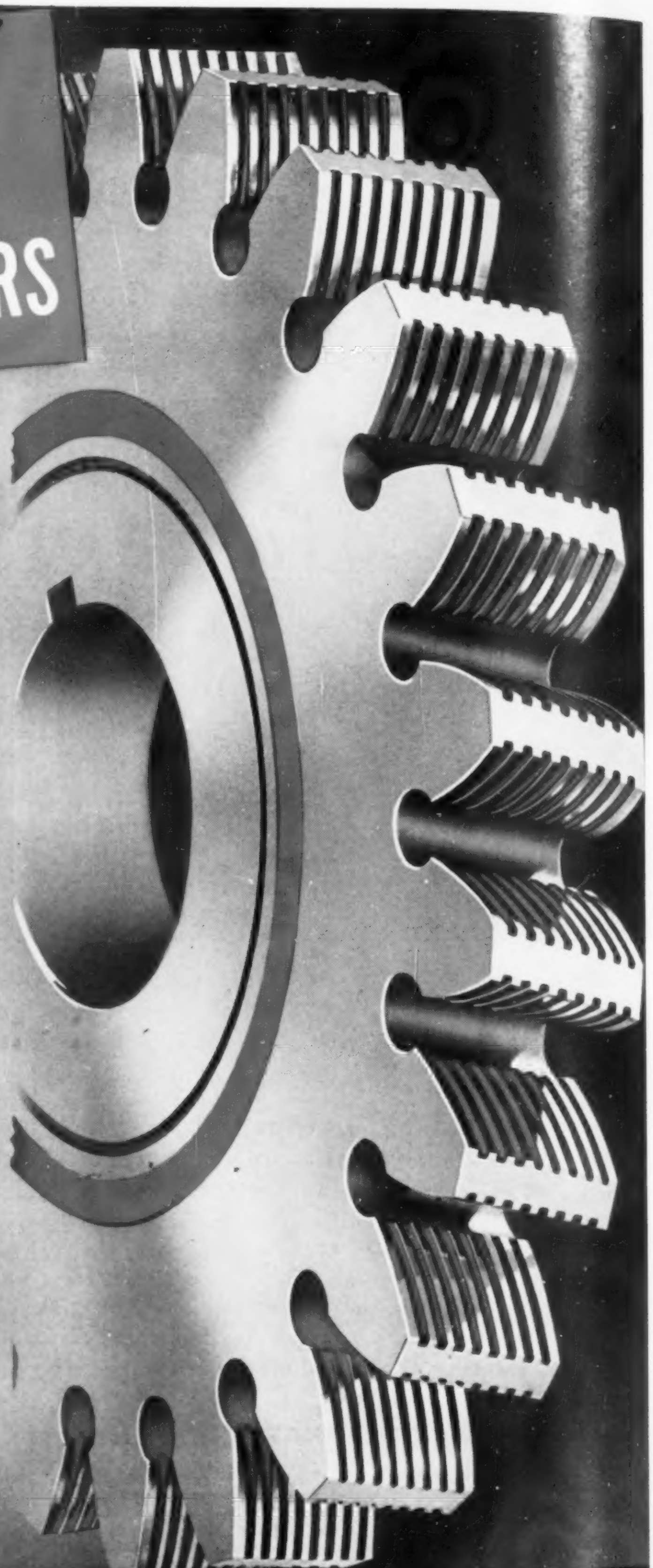
Position__________

Company__________

Address__________

City______ Zone___ State______

CHECK LIST FOR BUYERS OF SHAVING CUTTERS



Knowing the absolute necessity for QUALITY in your gear shaving cutters, you might consider these points the next time you order.

1. How much experience does the cutter manufacturer have?

   Since 1932 when National Broach built the first Rotary Gear Shaving Machine, this company has always been the largest producer of shaving cutters.

2. Has the cutter manufacturer a staff of engineer specialists who concentrate exclusively on cutter design?

   National Broach has such a staff.

3. Does the cutter manufacturer heat treat his own tools and is his grinding department temperature controlled?

   Every Red Ring Cutter is heat treated and controlled by Red Ring metallurgists and ground on special Red Ring grinders under precise temperature control.

4. Does the cutter manufacturer prove every cutter design by actual try-out in his own plant before it is released?

   No new Red Ring cutter design is ever released otherwise.

5. Is the cutter manufacturer prepared to assist you in cutter development — involute modification, etc. when needed?

   National Broach has always maintained such a service for you.

For further information, write for Chapter 2, Modern Methods of Gear Manufacture.

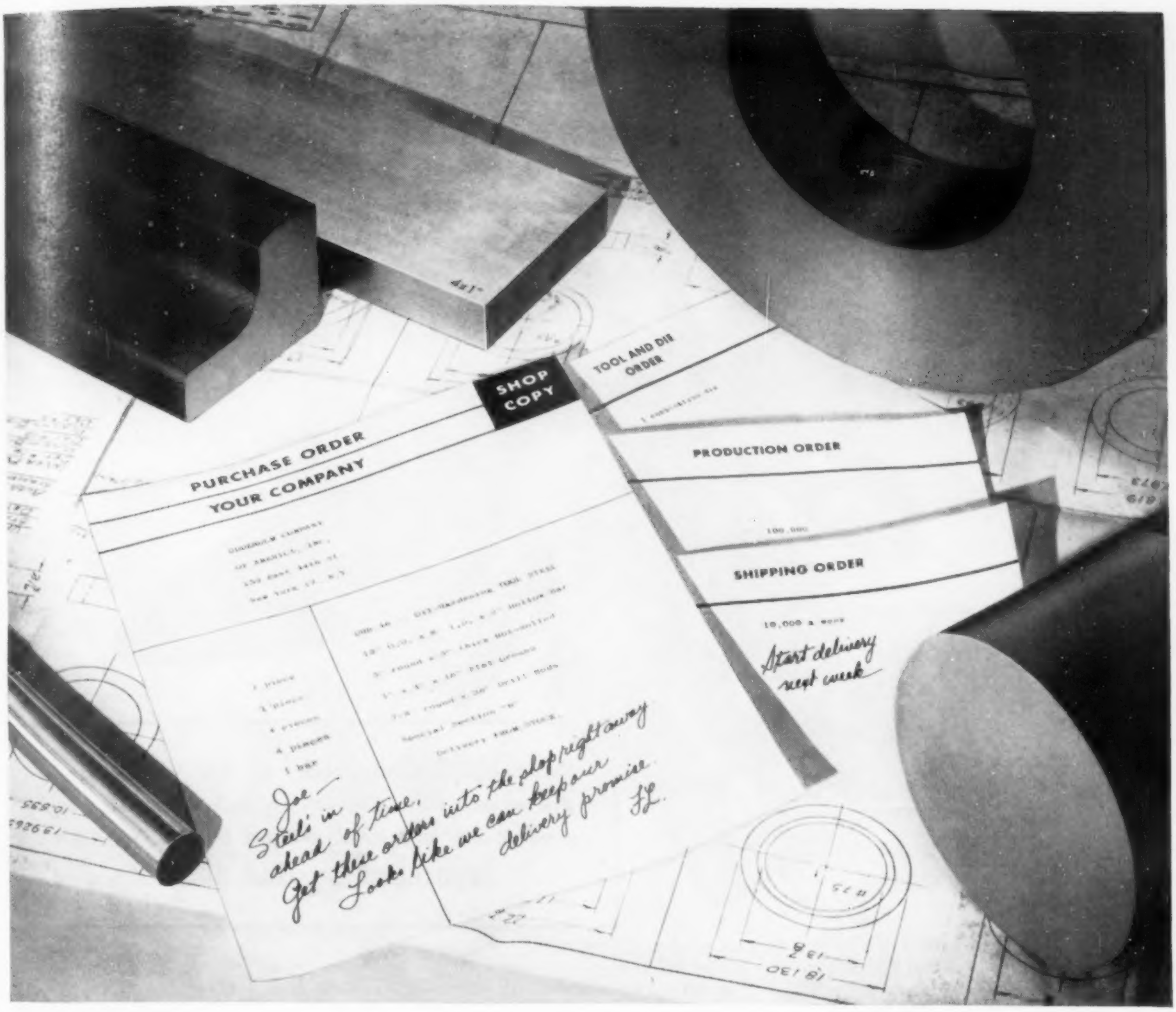
SPUR AND HELICAL GEAR SPECIALISTS . ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORM

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN . . . . DETROIT 13, MICHIGAN

7029

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT



GET TOOL STEEL FAST—FROM UDDEHOLM

Before anything can be done on a metal-working job, the tool steel must be on hand. No die or tool can be made, no production started, and no orders delivered without it.

Furthermore, the need for tool steel is usually urgent—sometimes you need it "yesterday". Therefore, place your order with a source that has an extremely wide variety of grades, shapes, sizes, and finishes in stock—Uddeholm.

For instance, UHB-46 oil-hardening tool steel is stocked in all these forms: drill rods, flat ground stock, hot-rolled bars, special sections, and hollow bars.

Warehouses in New York, Cleveland, and Los Angeles.

WANT A STOCK LIST OF UDDEHOLM TOOL STEELS?

UDDEHOLM, 155 East 44th St., New York 17, N. Y.
Please send me ...... tool steel stock lists.

NAME____________________

TITLE____________________

COMPANY____________________

ADDRESS____________________

CITY__________ZONE______STATE______

UHB

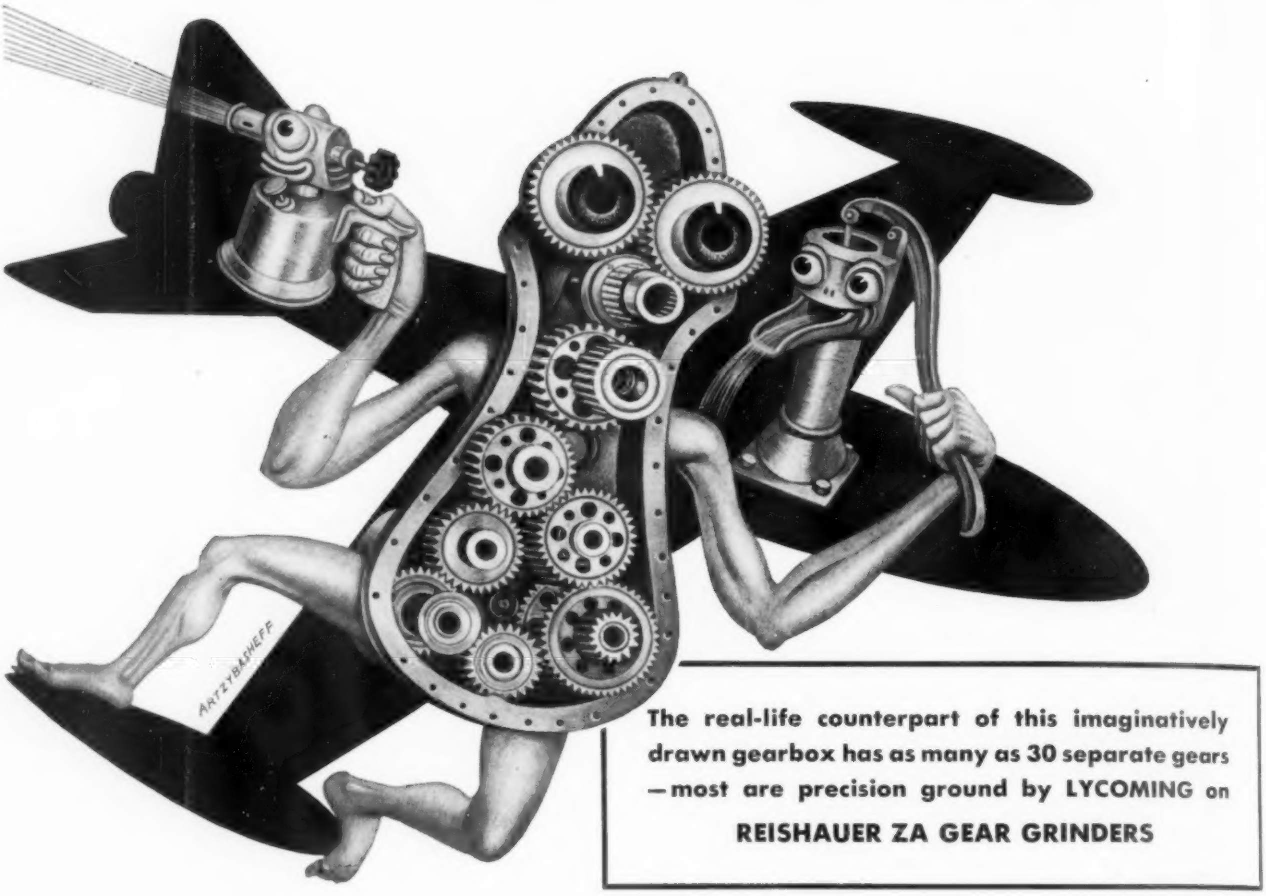
UDDEHOLM COMPANY OF AMERICA, INC.

Tool and Die Steels
Specialty Strip Steels

New York: 155 East 44th Street, MUrray Hill 7-4575
Cleveland: 3756 Carnegie Avenue, HEnderson 1-7440
Los Angeles: 5037 Telegraph Road, ANgelus 2-5121

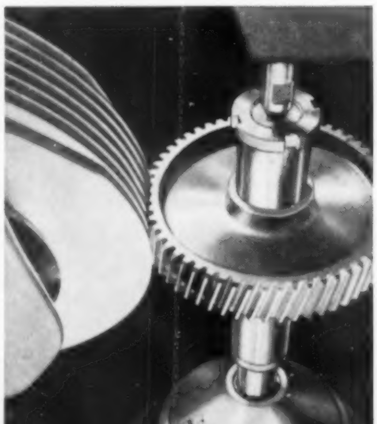
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-219

Precision gears go flying



The real-life counterpart of this imaginatively drawn gearbox has as many as 30 separate gears —most are precision ground by LYCOMING on

REISHAUER ZA GEAR GRINDERS



Single-thread grinding worm and spindle of the Reishauer ZA.

Auxiliary "nerves" of the mighty J-40 and J-47 jet engines, these precision gears transmit power to run fuel and oil pumps, generators, and other vital accessories. Lycoming, maker of this intricate gearbox, depends on Reishauer ZA gear grinders for precise, rapid production of gears.

Lycoming likes the way Reishauer consistently produces gears to extremely close tolerances at high production speeds. Furthermore, operators on the production line benefit from the simplicity and cleanliness of the machines' operation.

Lycoming is not alone in its respect for Reishauer grinders—these machines are widely used to grind spur and helical gears in the automotive and aircraft industries. Other users include machine tool builders, gear-jobbers, and instrument manufacturers.

In short, Reishauer ZA grinders are excellent machines. If you want proof, we'll be happy to supply it. Get in touch with us soon, won't you?

COSA *nationwide sales and service of precision machine tools —from bench lathes to boring mills.*

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-221

26 CUTTERS ON THIS SPECIAL TOOL BORE, TURN AND FACE HOLES RANGING FROM 22.500" TO 55.75" IN DIAMETER

LARGE

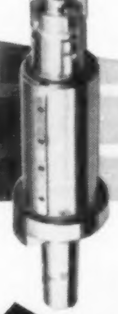
or small . . .

DAVIS

IS THE FIRST NAME TO CALL WHEN YOUR MACHINING NEEDS

Job-Engineered

SPECIAL TOOL DESIGNS



2 BLOCK-TYPE CUTTERS IN THIS SPECIAL TOOL ROUGH, FINISH AND COUNTERBORE HOLES RANGING FROM 2.180" TO 2.420" IN DIAMETER

Yes, large or small, simple or complex, you always tool jobs better with Davis. One reason is the big, extra bonus of machining know-how that goes into every Davis tool.

In the design of special tools, like those above, Davis' broad experience and unsurpassed engineering skill assure recommendations complete in every detail of speeds, feeds, fixtures and maximum combination of multiple operations into single tools for increased production at lowest cost.

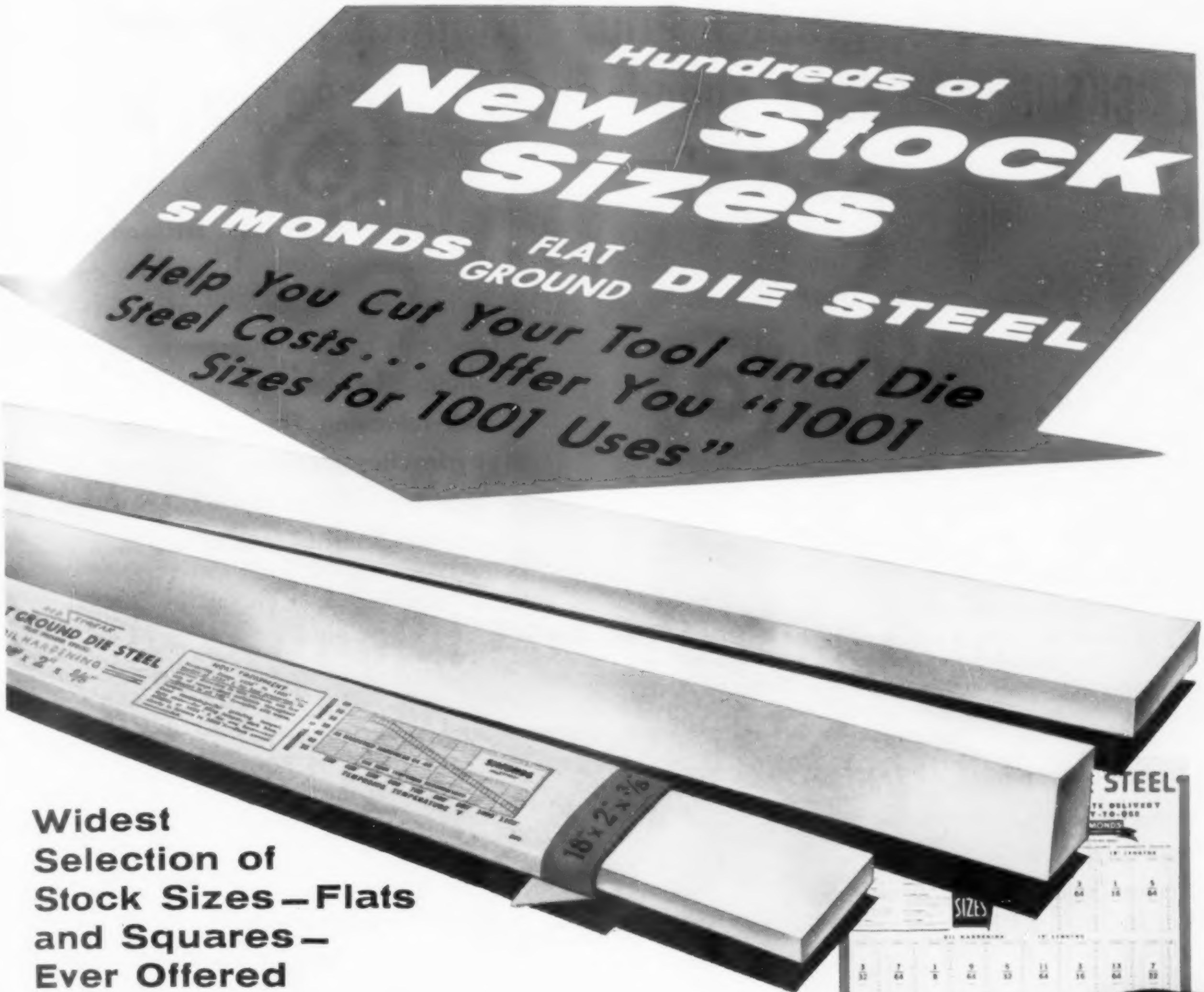
DAVIS ALSO OFFERS INDUSTRY'S MOST COMPLETE STANDARD TOOL LINE

In standard blocks, boring heads, bars, and tool sets, the Davis line features thousands of items to assure unrestricted selection in tooling up virtually any routine job.

Your local Davis Field Engineer is as close as your telephone, and behind him are the complete facilities of Davis' application engineering department, ready to serve you with special or standard tools.

DAVIS BORING TOOL DIVISION of
Giddings & Lewis Machine Tool Company
Fond du Lac, Wisconsin

THE ONE NAME THAT CERTIFIES ULTIMATE PRECISION AND PRODUCTIVITY IN TOOLING



Widest Selection of Stock Sizes—Flats and Squares—Ever Offered

Toolmakers, punch and die makers, machinists and others using tool and die steel can eliminate expensive "grinding to size" by using Simonds precision ground high grade tool steel. With hundreds of newly added stock sizes to choose from, you're almost certain to find the exact size you need so that you save both time and material cost. What's more, you have a choice of time-tested OIL HARDENING or AIR HARDENING type steel, whichever you require. Stock sizes are ready for immediate delivery. Get full information, including New Wall Chart (18″ x 31″) and Data Book from your Simonds Die Steel Distributor.

OIL HARDENING TYPE — Non-deforming, spheroidize-annealed for best machinability and consistently uniform hardenability — from Simonds own steel mill. Extra-smooth finish with all decarburization and surface defects removed. Wide hardening range. Individually packaged (18″ and 36″ lengths) with simplified heat treating instructions.

AIR HARDENING TYPE — Non-deforming, spheroidize-annealed, 5% chrome — more wear-resistant yet easy to machine and heat treat with uniformly excellent results . . . another product of Simonds steel mill. Decarburization and surface defects removed. Wide hardening range. Individually packaged with heat treating instructions.

SIMONDS SAW AND STEEL CO.
FITCHBURG, MASS.

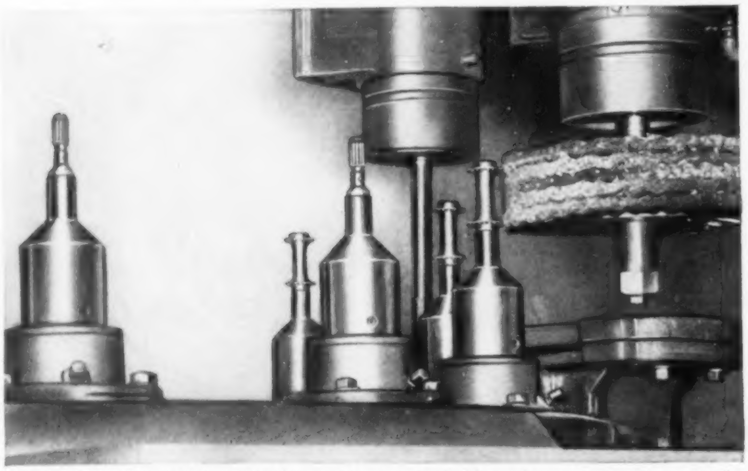
FLAT GROUND DIE STEEL

For Fast Service from Complete Stocks

Call your SIMONDS Industrial Supply DISTRIBUTOR

Factory Branches in Boston, Chicago, San Francisco and Portland, Oregon
Canadian Factory in Montreal, Que.
Simonds Divisions: Simonds Steel Mill, Lockport, N. Y.
Simonds Abrasive Co., Phila., Pa., and Arvida, Que., Canada

Self-release, greater grip, automatic alignment of ERICKSON MANDRELS speed small to large part loading



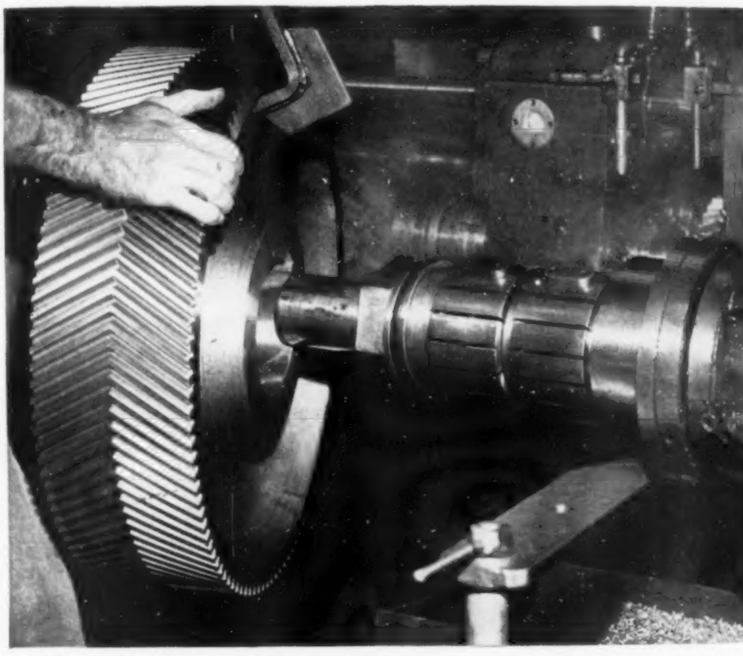
SMALL ERICKSON MANDRELS play a big part in holding down production costs for leading bicycle parts manufacturer. Here you can see how Erickson drawbar-operated, precision expanding mandrels speed wheel hub loading for buffing operation. Ease of operation and instantaneous release have greatly speeded this quantity production holding problem.

Regardless of size, Erickson precision expanding mandrels operate on Erickson's famous double-angle principle that not only assures guaranteed accuracy of .0005" T I R, but also makes mandrels self-releasing. They are available for air, hydraulic or manual operation. Special mandrel sleeves are designed to match various internal forms.

ERICKSON MANDREL ADVANTAGES

- Instantaneous self-release greatly speeds loading and unloading
- Greater holding power because grip extends over entire sleeve length . . . stops wobble and chatter
- Guaranteed accuracy of .0005" T I R
- Each sleeve covers a range of 1/32"
- Sleeves are interchangeable on mandrels of same series

Are you bothered by a tough internal holding problem? Then let us prove that Erickson mandrels speed production for lower unit costs. Give us a call today or write for catalog K.



ERICKSON MANDRELS speed large part handling, too. See how easily this heavy shovel gear, 24 inches in diameter, is being loaded for gear cutting at the Alten Foundry and Machine Works, Inc., Lancaster, Ohio. Larger shovel gears up to 61 inches in diameter are handled just as easily. At Alten Foundry, using an Erickson mandrel, loading and automatic alignment require only 10 percent of the time required by plants using solid arbors and arbor presses. Even this large mandrel is self-releasing. Operator fatigue is practically eliminated.

ERICKSON Holding Tools
.0005
Guaranteed Accuracy

ERICKSON TOOL COMPANY

2303-J Hamilton Avenue • Cleveland 14, Ohio

COLLET CHUCKS • FLOATING HOLDERS • TAP CHUCKS • TAP HOLDERS • AIR-OPERATED CHUCKS
EXPANDING MANDRELS • SPECIAL HOLDING FIXTURES

LOOK

Series 6600
Solenoid Pilot Operated.
Furnished in 1/2", 3/4", 1"
1-1/4" and 1-1/2" I.P.S.

RIVETT OFFERS *NEW*

gasket-mounted hydraulic valves

4-way 3000 p.s.i.

Designed and Built to J.I.C. Standards

Series 6500
Direct Solenoid Operated.
Furnished in 1/4" I. P. S.

Advanced features offer you broader opportunity for control

1. Greater flow capacity. (Ex: 6600 series ¾" size rated at 28 G.P.M. at 15 ft. per sec.)
2. Less pressure drop.
3. More compact in size.
4. Seven spool designs for 3 and 4-way control.
5. Dust sealed and moisture resistant. Roomy wiring box.
6. Continuous duty, shock mounted solenoids. 3.6 amps inrush and .45 amps holding at 115 V.
7. Shock resistant spool. Scalloped design and metering grooves eliminate impact.
8. All surfaces precision ground.
9. May be mounted in any position.
10. High tensile, nickel alloy body.

RIVETT LATHE & GRINDER, Inc.
Brighton 35, Boston, Mass.

COMPARE and PROVE!
Get new Catalog—

shows *why* new Rivett gasket-mounted solenoid pilot valves are best; illustrates flow operations for all piston designs. This book is a must on every board—easy to understand, it will simplify your valving problems. Write today!

Rivett Lathe & Grinder, Inc., Dept. TE-1,
Brighton 35, Boston, Mass.
Please send free Catalog 260.

Name ____________________
Company ____________________
City ____________________ State ________

RIVETT

furnishes a complete power package

VALVES • CYLINDERS • POWER UNITS

Air and Hydraulic • All sizes and types

 FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-225

IF

You Must Cut Production Costs

THEN

Without Machining, You Can:

- Accurately locate and secure drill bushings,
- Center and secure shafts in Alnico rotors,
- Anchor spindles in abrasvie wheels,
- Locate and secure fixture fittings in assembly frames,
- Anchor sleeve bearings and non-moving parts in machinery.

Bulletin A1 shows how Cerro Alloys can save time and money in above operations. Write for it today.

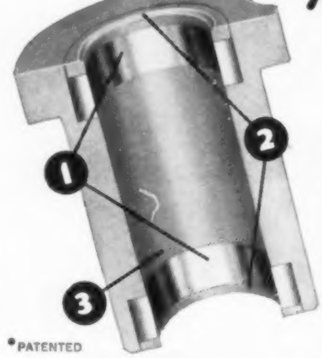
Visit Booth 558, A.S.T.E. WESTERN SHOW, Los Angeles, Calif. March 14-18, '55. Above applications and many others will be on display.

CERRO DE PASCO CORPORATION

Dept. 3, 40 Wall St., New York 5, N. Y.

USE READER SERVICE CARD; INDICATE A-1-226-1

MORE HOLES— MORE ACCURACY— FASTER— AT LESS COST



*PATENTED

1. Tungsten carbide rings at the points of wear; **2.** Steel rings protect drills and carbide; **3.** Special hardened alloy steel body.

For information and prices write for Meyco Bushing Catalog No. 42

MEYCO

Carbide Inserted Bushings Are Doing It Daily!

HOW? Like this: **(1)** Last longer... with a life—in most cases—as long as solid carbide bushings at prices that come close to the prices of ordinary steel bushings; (2) Increased life for your drill jigs and fixtures; **(3)** Increased life for your drills and reamers; **(4)** Accuracy maintained for a LONG PERIOD of time; **(5)** Less non-productive machine time, less lost man-hours, because bushings need not be changed as often; **(6)** Inspection time saved, because of greater accuracy for a longer time; and **(7)** Less waste due to spoilage, for the same reason. Don't pass up a good bet! Get the dope on MEYCO Carbide Inserted Drill Jig Bushings today!

W. F. MEYER'S CO., INC., BEDFORD, INDIANA

USE READER SERVICE CARD; INDICATE A-1-226-3

PEECO'S HELPING HAND

small parts FEEDING

INHERENT TO AUTOMATION

PEECO engineered cast bowls scientifically solve small parts feeding problems. Small parts flowing to automatic operations are easily regulated to production speeds with PEECO engineered parts feeders. PEECO single or multi-track engineered bowls safely select, reject, and inspect parts without damage or jamming. You'll like to do business with PEECO. Insist on a PEECO parts feeder—it's engineered. Write for catalog, "Operation—Automation."

Small parts feeding is PEECO'S business—not a side line.

Peeco VIBRATORY PARTS FEEDERS — PERRY EQUIPMENT & ENGINEERING CO.

Dept. 30, 3125 BRANDES ST., ERIE, PA.

USE READER SERVICE CARD; INDICATE A-1-226-2

DYKEM STEEL BLUE®

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303D North 11th St. • St. Louis 6, Mo.

USE READER SERVICE CARD; INDICATE A-1-226-4

Fellows

MACHINES and TOOLS

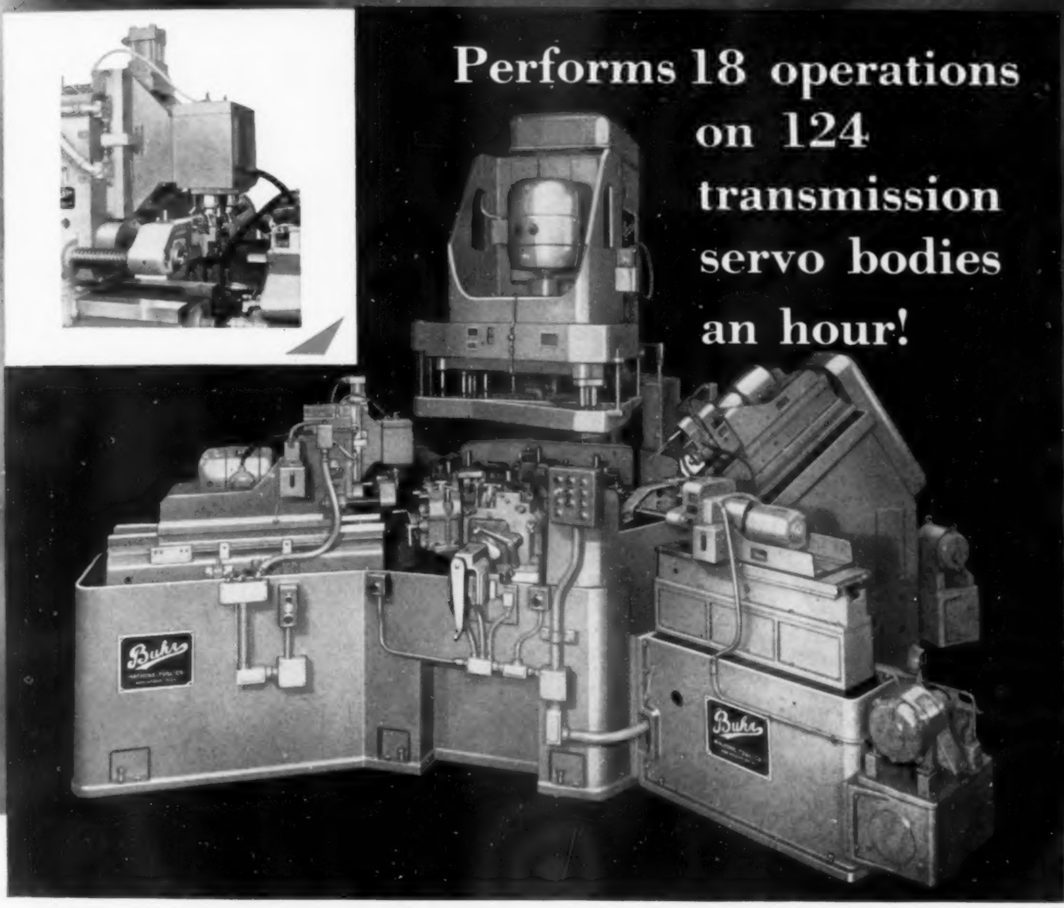
FOR CUTTING
. . . SHAVING
. . . BURNISHING
AND INSPECTION

in GEAR PRODUCTION

THE FELLOWS GEAR SHAPER COMPANY, SPRINGFIELD, VERMONT

USE READER SERVICE CARD; INDICATE A-1-226-5

Buhr SPECIAL...

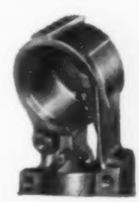


This 5-way automatic-indexing dial-type Buhr Special has a 6-station, 2-position fixture which features relocating the part in each fixture.

Especially noteworthy is the *special milling head* arranged with automatic back-up so that cutters do not disturb the close micro-finish on their return stroke. (See inset blowup above.)

A tool board is used to keep tool-changing time to minimum.

Multiple heads are of Buhr ball-bearing construction with shaved gears and broached-and-splined drives — a Standard Feature on all Buhr Specials.



Available at your request — our 48-page Catalog or a consultation with one of our sales executives.

Buhr

BUHR MACHINE TOOL COMPANY

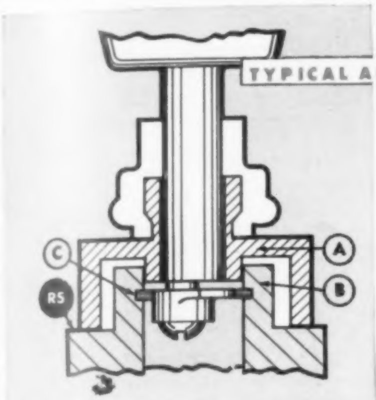
252 GREEN STREET, ANN ARBOR, MICHIGAN

MULTIPLE-SPINDLE HIGH PRODUCTION MACHINERY

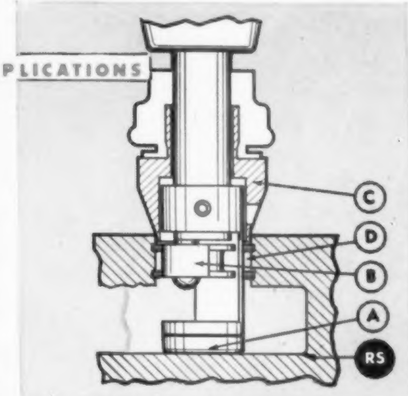
Solidly Engineered . . . Precision Built . . . for World's Leading Manufacturers

Waldes Truarc Grooving Tool Out-Performs Conventional Recessing Tools

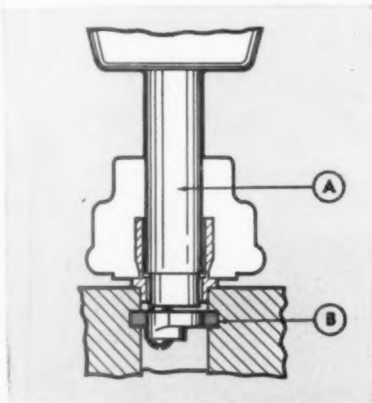
SAVES TIME! CUTS COSTS! NEEDS NO SKILLED LABOR!



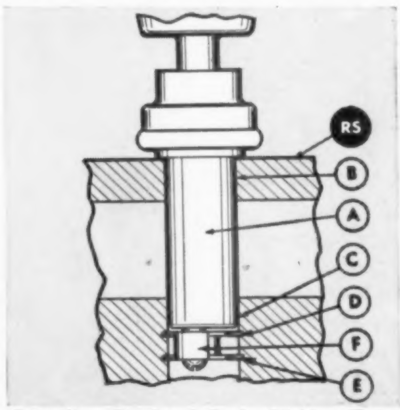
Clearing Obstructions or Protrusions — Waldes Truarc Grooving Tool with *special bushing* with high shoulder A in order to clear obstruction B on reference surface RS so groove can be properly located in bore.



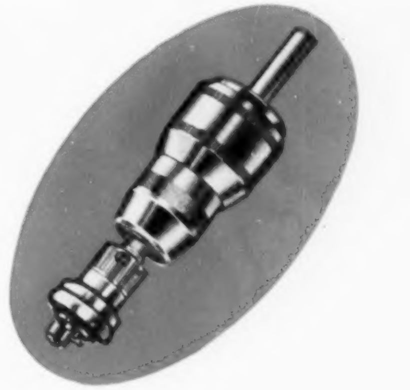
Locating Grooves from Bottom of Hole or Blind Hole—Use of *bottom adaptor* A and double cutter B. Bushing C pilots tool into bore D while bottom adaptor acts as stop to locate grooves from reference surfaces RS below bore.



Small Diameter Bore — Need for Wide Groove — Great versatility of tools allows A-2 Tool to accept *stepped down spindle* and *cutter-shaft* assembly A. Provides cutting capacity in a bore normally within the range of smaller A-1 Tool. Illustrated, larger tool capacity necessary to cut groove diameter B exceeding normal capacity of standard A-1 Tool.



Extending Reach of Tool — Waldes Truarc Grooving Tool assembled with *extended bushing* A increases normal range of tool in order to reach proper groove location in bore. Bushing also registers on reference surface RS of workpiece while piloting tool at two points B and C inside bore. Two grooves D and E are cut simultaneously with double cutter F.

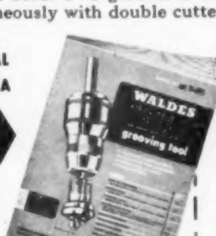


AMAZINGLY VERSATILE! The Waldes Truarc Grooving Tool adapts quickly and simply to your toughest recessing requirements. With it, even *unskilled labor* can perform and maintain high precision, mass production operations.

WIDE CUTTING RANGE! The Waldes Truarc Grooving Tool comes in five models: A-1, A-2, A-3, B and C. This wide variety of models enables you to cut accurate grooves in housings with diameters from .250 to 5.000 inches. Special features, modifications and adaptations allow each model to operate efficiently under many varying conditions.

SEND YOUR PROBLEM TO WALDES! Whatever your internal grooving problem, send us your blueprints and let Waldes Truarc engineers give you a complete analysis, price quotation and delivery information on the most economical tool set-up for your particular job.

WRITE NOW FOR 20 PAGE TECHNICAL MANUAL CONTAINING FULL ENGINEERING DATA



WALDES TRUARC Reg. U. S. Pat. Off. **GROOVING TOOL**

MADE BY THE MANUFACTURERS OF WALDES TRUARC RETAINING RINGS.

WALDES KOHINOOR, INC., 47-16 Austel Pl., L.I.C. 1, N.Y. Waldes Truarc Grooving Tool mfd. under U.S. Pat. 2,411,426

TE017

Waldes Kohinoor, Inc., 47-16 Austel Place
Long Island City 1, New York

Please send me your new 20-page technical manual on the Waldes Truarc Grooving Tool.

Name________________

Title________________

Company________________

Business Address________________

City________ Zone____ State________

You have a date!

MARCH 14 · MARCH 15 · MARCH 16 · MARCH 17 · MARCH 18

An Unprecedented 5-Day Event

The West's biggest exposition of production equipment and manufacturing processes . . . tailored to the specific needs of western industry . . . Tools, Machines, Accessories, Controls, Inspection Methods and Equipment, Quality Control and Automation Devices.

what's new and important to you discussed at sessions of the 23rd Annual Convention of the ASTE, plus sessions of the Society of Plastics Engineers and the American Society for Quality Control—a program tailored to YOUR needs. Covered will be such vital topics as: tool engineering aids, pressworking, plastic and ceramic tooling, production planning and management training in-plant and out, machining without cutting, precision casting, ordnance production, determination of tolerances, heat treating, etc.

In LOS ANGELES

Shrine Auditorium and Exposition Hall

★ **The First ASTE Western Industrial Exposition.**

★ **The Most Vital All-Industry Production Conferences ever convened in the West.**

To help you select the days most important to the various key men in your organization, ASTE has a limited number of its 1955 Plan Books available without charge to industrial executives. Ask for it on your company letterhead today.

AMERICAN SOCIETY OF TOOL ENGINEERS

10700 Puritan Ave. • Detroit 38, Michigan


GREENFIELD
1 1/2-6 NC

Closeup of mandrel, Ampco-coated steel balls fill tube during bending, prevent walls from collapsing.

Completed bend in Pines Precision Bending Machine.

Pines Engineering licks "impossible" job

... bends ultra-thin stainless tubing
... cuts airplane costs $14,000
thanks to **AMPCO* METAL**

AIRCRAFT engineers said that cold bending of thin-wall tubing sections for engine and airframe components was impossible — that it couldn't be done. But Pines Engineering Co., Aurora, Illinois, went to work anyway It developed a precision bending machine that makes smooth, sharp bends to 10" centerline radius in up to 5" diameter x .025" wall stainless tubing — bends that are cutting airplane costs up to $14,000 each.

Pines selected Ampco Grade 20 wiper dies and Ampco-coated mandrels for their new precision machine to resist the tremendous pressures developed in this bending operation. Here's what they say:

"Ampco eliminates the problem of pickup on the mandrel and wiper die when bending stainless steel tubing. And Ampco provides a hard-wearing surface that enables the production of thousands of bends before dies have to be refitted."

And if you draw, form, or bend stainless, pickled carbon steel — or many other metals — here's what *you* get with Ampco dies:

Little or no pickup. You eliminate all the expense of redressing steel dies — redressing that is necessary because of scratching, galling, or pickup. Idle time is cut — and your line keeps moving at top production.

Low finishing costs. You end galling, loading, scratching, die marks. No more problems with big scrap losses. You reduce expensive finishing time.

This remarkable copper-base alloy pays off on your drawing or forming line with longer life, lower costs, less operating grief. Get all the facts on cost-saving Ampco dies from your nearby Ampco field engineer or mail the coupon.

Tear out this coupon and Mail Today!

LET AMPCO PROVE ITS ~~METAL~~ *mettle*

AMPCO

Sole producer of genuine Ampco Metal

*Reg. U. S. Pat. Off.

Ampco Metal, Inc.
MILWAUKEE 46, WISCONSIN
West Coast Plant • Burbank, California

Ampco Metal, Inc., Dept. TE-1, Milwaukee 46, Wisconsin

I'd like to know more about time- and money-saving Ampco dies. Please send me more information.

Name.................... Title....................

Company....................

Company Address....................

City.................... (.....) State....................

D-39A

THE MOTCH & MERRYWEATHER CUTTING TOOL MANUFACTURING DIVISION

offers you . . .

cutting tool aids to production

ASK YOUR DEALER ABOUT EVERY ONE OF THEM

• Get the full story on Motch & Merryweather's complete line of saw blades and slitting-slotting saws — a type, size, and thickness for *every* purpose. Triple-Chip cut-off blades up to 108" diameter down to slitting saws 3" in diameter — special saws — for any machinable material, ferrous or non-ferrous, any size, any shape, any thickness. Ask how the M & M Triple-Chip Method reduces tooth strains, prolongs blade life and speeds production with accuracy.

KROSLOK® FACE MILLING CUTTERS and SHELL END MILLS

Simplicity itself!

Only 3 members — body, blade, wedge. Waffle design of body mates *rigidly* with waffle design in body. Cuts any machinable material. A profit-showing investment in *precision* production milling.

TRIPLE C® GRINDING COOLANT

Clear — Cool — Clean!

Triple C® grinding coolant makes for improved results and lower costs on all wet grinding. Transparent, stable solutions; maximum cooling; grinding wheels stay clean and free-cutting.

TRIPLE-CHIP HEAVY DUTY ANTI-WELD SOLUBLE OIL

M & M Heavy Duty Anti-Weld Soluble Oil lengthens tool life, especially under severe conditions. Deters "pick-up", cuts rejects, is oily (not greasy), odorless; lowers production costs.

THE MOTCH & MERRYWEATHER MACHINERY CO.

Cutting Tool Manufacturing Division

1250 EAST 222nd STREET, CLEVELAND 17, OHIO

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-235

Holes on extremely close centers vary in diameter from 1/16" to 13/16". The valve body has 33; the cover, 18.

"—BUT OUR PRODUCTION RUN IS LIMITED."

"SO WAS THE RUN ON THIS AUTOMATIC TRANSMISSION PART, BUT". . . .

HERE'S HOW ZAGAR TOOLING SAVED MONEY HAND OVER FIST

This aluminum die casting is processed in its entirety by Zagar planning, except for milling two faces. Two lines of Zagar standardized self-clamping drill jigs ream, tap and drill both valve body and cover. With 24 heads and 24 fixtures, Zagar performs work on 51 holes on close centers. Step tools take care of reaming and burnishing. The fixtures were designed to compensate for slight inaccuracies in the die casting. Thus has Zagar engineering solved an acute problem of limited production without the purchase of costly special machines.

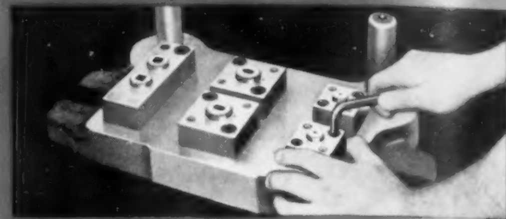
ZAGAR TOOL, INC.
24000 LAKELAND BOULEVARD • CLEVELAND 23, OHIO

Ask on your letterhead for Bulletin "E-1".

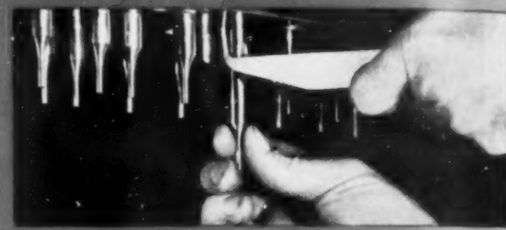
Zagar TOOLS FOR INDUSTRY and SPECIAL MACHINERY

WHERE R-B Punches cut your costs

in die designing



in die construction



in die operation

IN DIE DESIGNING

. . . you save "board time" by working with the standardized R-B concept of punches, die buttons, punch retainers and die button retainers. R-B standardized equipment reduces drafting time to cut your costs.

IN DIE CONSTRUCTION

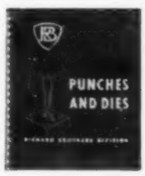
. . . you save "building time" because R-B punches, die buttons, punch retainers and die button retainers are furnished completely finished. R-B saves skilled die-maker's time to cut your costs.

IN DIE OPERATION

. . . you save "press time" because R-B punches and die buttons are instantly removed and replacements quickly inserted. Inherent accurate alignment and positive locking keep press down-time at a minimum to cut your costs.

Use R-B Engineering Service for Your Tough Piercing Problems.

RICHARD BROTHERS PUNCH DIVISION
ALLIED PRODUCTS CORPORATION
DEPT. 75 • 12667 BURT RD., DETROIT 23, MICH.



Please send me additional information.

NAME ____________ TITLE ____________

COMPANY ____________

ADDRESS ____________

CITY ____________ ZONE ______ STATE ____________

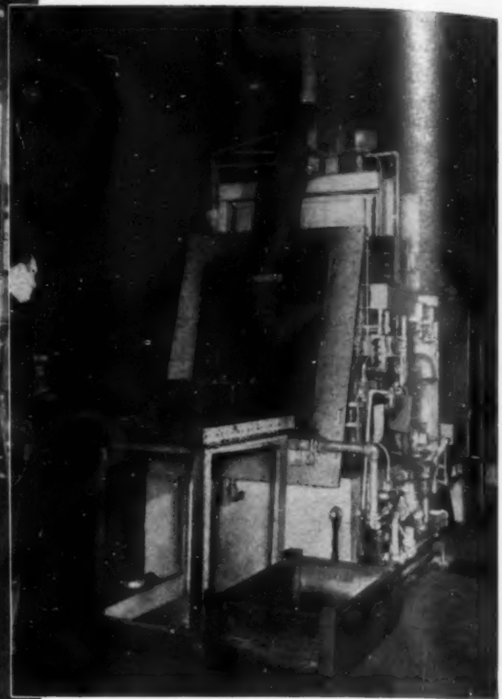
Also Produced in
OTHER ALLIED PLANTS

SPECIAL COLD FORGED PARTS

STANDARD CAP SCREWS

PRECISION GROUND PARTS

SHEET METAL DIES MADE OF FERROUS ALLOYS, ZINC ALLOYS OR PLASTICS



Left: New England Metallurgical Corporation installed first Lindberg Carbo-nitriding Furnace at Worcester plant.

Above: Six months later New England Metallurgical installed second Carbo-nitriding Furnace at Boston pant.

One *LINDBERG* Carbo-nitriding Furnace merited another at New England Metallurgical Corporation

"Our first Lindberg Carbo-nitriding furnace in January . . our second one installed just 6 months later!" Yes, that's what happened in the plants of New England Metallurgical Corp., Boston, Mass., for more than 28 years well known commercial heat treaters.

The first unit, a gas fired, radiant tube, carbo-nitriding furnace went to the company's Worcester plant known as Greenman Steel Treating Company.

Six months later a second Lindberg Carbo-nitriding furnace was installed in the Boston plant of New England Metallurgical Corporation . . and this team of versatile "work horses" have been continually turning out production . . 24 hours a day.

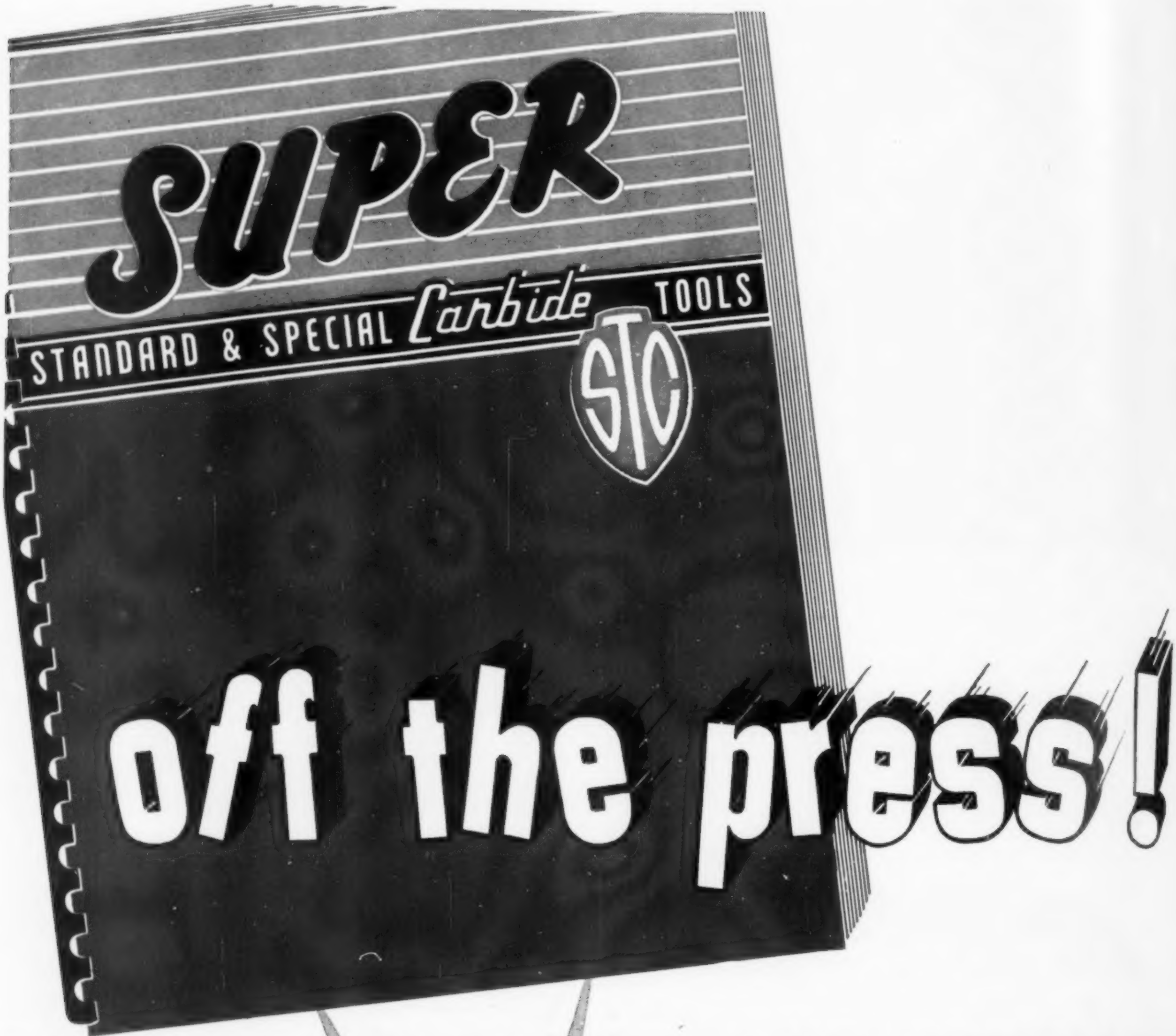
Mr. Lloyd Field, Vice-President and General Manager of the Worcester Division, has this to say about the Lindberg Carbo-nitriding Furnaces: "We selected Lindberg Carbo-nitriding Equipment for the usual reasons . . cost cutting . . uniform, quality work . . high, dependable production. But more than that . . as you know, variety seems to be the spice of a commercial heat treater's life, and because of the versatility of the Lindberg Carbo-nitriders, which are actually five furnaces in one, they are without doubt our busiest and most valuable pieces of equipment.

"When customers send in work for carbo-nitriding, carburizing, neutral hardening, annealing, or carbon restoration, a hue and cry goes up to check for room on the heavy schedules of the Lindberg Carbo-nitriding Furnaces."

Lindberg Carbo-nitriding Furnaces can do a job for you, too. Ask for bulletin No. 241.

LINDBERG FURNACES

Lindberg Engineering Company, 2447 W. Hubbard Street, Chicago 12, Illinois



THE MOST UP-TO-DATE AND COMPLETE CARBIDE TOOL CATALOG AVAILABLE

- ★ A completely new carbide tool catalog, shadow indexed for ready reference.
- ★ 92 pages contain complete listings on Super Standard Carbide Tools, sizes and engineering information.
- ★ Many new carbide tools cataloged for the first time, including an extended line of solid carbides.

Send for your copy today

SUPER TOOL CO.
21654 Hoover Road, Detroit 13, Mich.

Please send me my copy of Super catalog No. 55.

Name ______ Title ______

Company ______

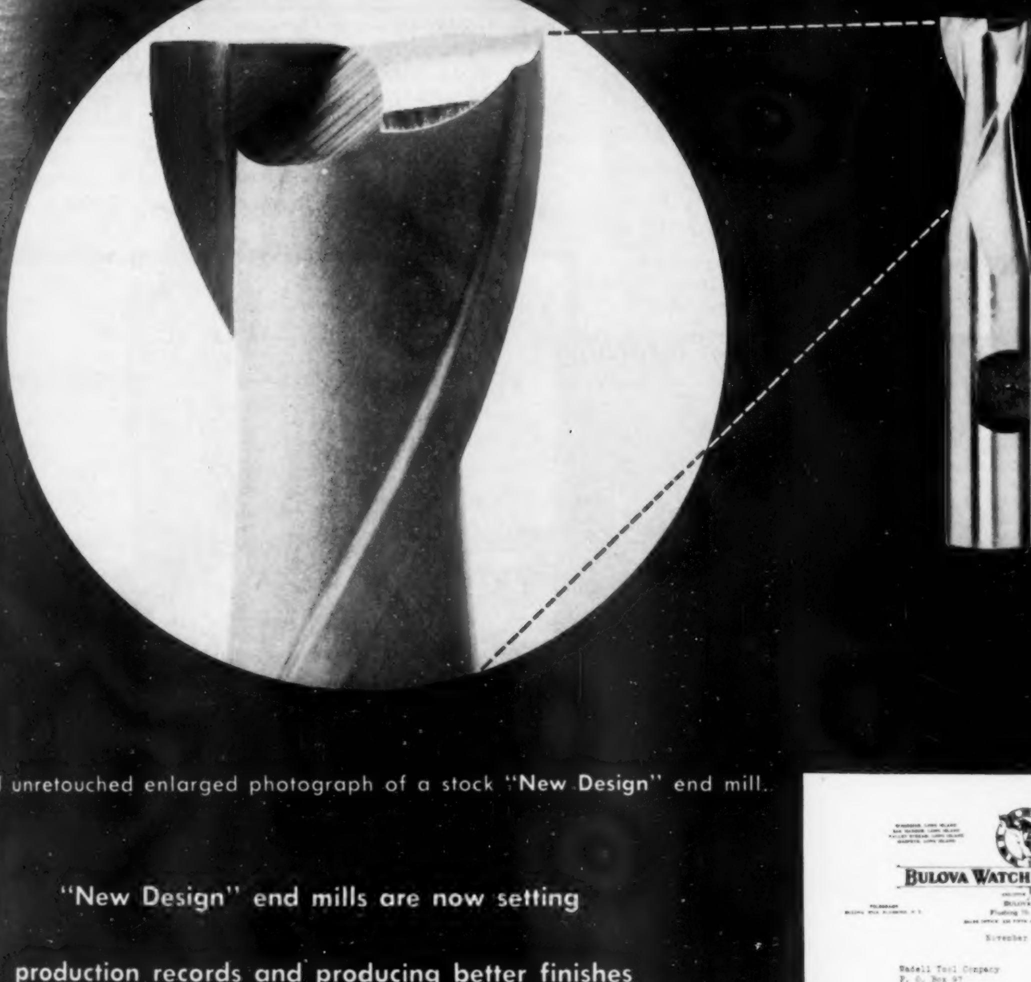
Address ______

City ______ Zone ______ State ______

Super
TOOL COMPANY

21650 Hoover Rd., Detroit 13, Michigan • 5210 San Fernando Rd., Los Angeles 3, California

Wadell Tools, the new leader in end cutting tools *invites you* to production test the "New Design" end mills.



Actual unretouched enlarged photograph of a stock "**New Design**" end mill.

"New Design" end mills are now setting production records and producing better finishes in some of the leading plants in the country.

Write for information and catalog.

BULOVA WATCH COMPANY, INC.

Bulova Park
Flushing 70, New York

November 19, 1954

Wadell Tool Company
P. O. Box 97
Raritan, New Jersey
Attention Mr. Massari

Dear Sir:

Our first experience with Wadell end mills was an attempt to find a solution to an extremely difficult milling problem. It amazed everyone from engineering and supervision to the man at the machine the way the cutter stood up piece after piece on the formerly troublesome operation.

It was a gradual transition of Wadell cutters from this job to other difficult jobs to standardization for all jobs, outlasting other cutters as much as ten to one.

Everyone in our manufacturing division will heartily recommend Wadell end mills for dependability, finish, and ultimate economy.

Very truly yours,

G. Brunner, Mfg. Superintendent

GB/ah.

AMERICA RUNS ON BULOVA TIME

WT

WADELL TOOLS

P. O. Box 97 • Raritan, New Jersey

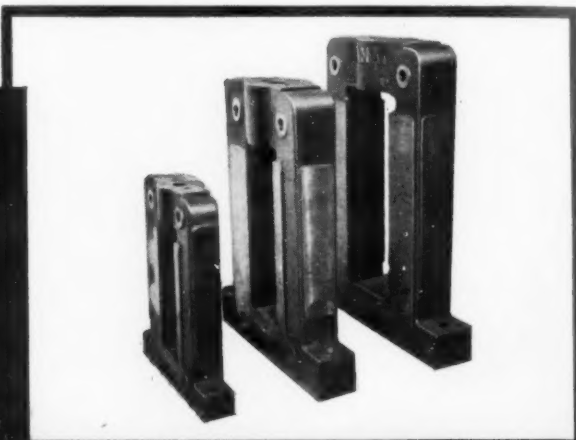
TERRITORIES AVAILABLE TO STOCKING MANUFACTURERS AGENTS

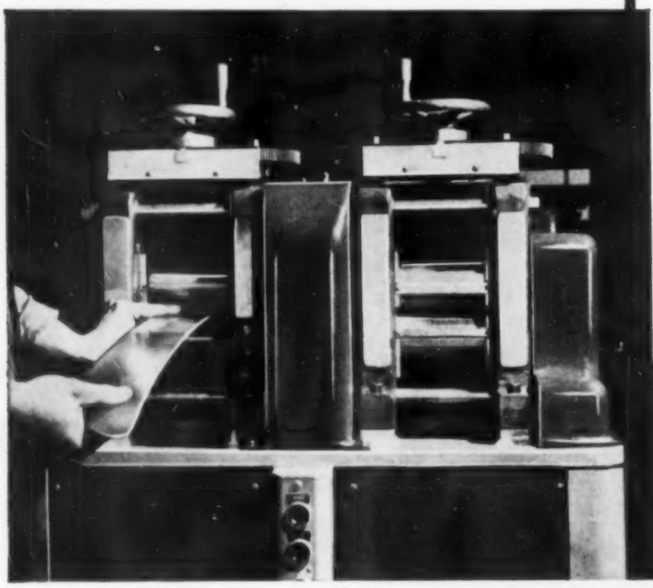
The MEEHANITE Casting Reporter

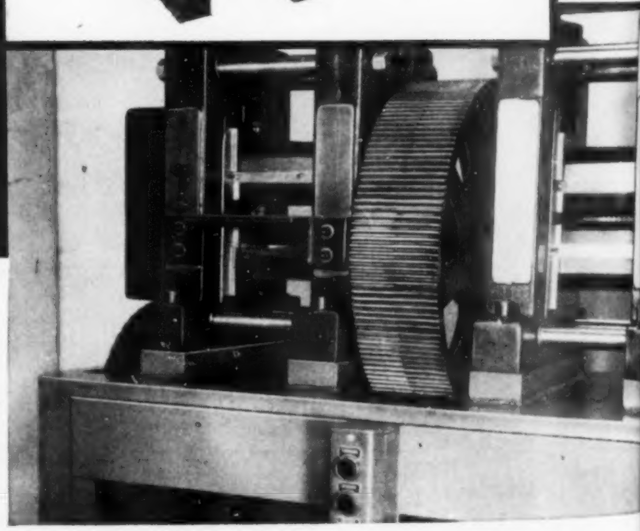
3 PROBLEMS SOLVED IN STANAT MILLS

The Stanat Manufacturing Company, Long Island City, New York, produce a line of small rolling mills used in both laboratory and industrial production. Three fundamental problems in the design and manufacture of these mills were encountered and solved as follows:

	PROBLEM	SOLUTION
1.	Subjection of frames to unpredictable stresses and shock in service.	Strong, tough, rigid Meehanite frames.
2.	Roll leveler—a unit for leveling strip stock up to $^3/_{16}''$ thick. Wide speed ranges and changing types of material impose intermittent shock loads.	Pressure lubrication achieved by rifle drilling Meehanite frames. Meehanite housings for pinch roll bearings for long life and soundness.
3.	Bull gear breakage—an unexpected application by customer resulted in gear breakage.	Bull gear redesigned to use heat treated Meehanite castings. No further breakage.







↑ Stanat three-inch combination mill assembled for rolling both flat and wire stock.

Heat treated Meehanite bull gears eliminated breakage in service. →

BUILDER SAYS:

"Generally, we use Meehanite castings for parts subject to high stress, heavy shock loading or where we desire dimensional stability during machining. Also, we use special heat treatable types of Meehanite metal in applications such as gears, and for rolls used in our mills for hot rolling.
The use of the Meehanite castings gives us greater design freedom, makes for more compact sizes and gives a product that we know will stand up to anything that can be reasonably be asked of a mill."

More

CAPACITY
...VERSATILITY
...RIGIDITY
...ACCURACY*

More for your money in the new U. S. VERTICAL MILLING MACHINE!

U. S. Vertical's balanced rigidity is the key to profitable production. Make the same comparison made by hundreds of plants. See why they find the U. S. Vertical to be the low-cost mill they demand. New "U. S." features include hard chrome plated quill, precision honed head and overarm bosses; and a quick change collet draw bar. Write today for complete details. The U. S. Burke Machine Tool Division, 16 Brotherton Road, Cincinnati 27, Ohio.

*Accuracy Certified! Check list showing results of actual inspection tests accompanies each machine.

Compare

FEATURES

- Balanced head and motor
- Simplified belt-speed changing
- Conveniently located reversing switch
- Protected knee gearing
- Lubricated-sealed ball bearings
- Built-in spot light
- Swing-out Tool-Keeper
- Guaranteed close tolerances*
- Hardened and ground lead screws (optional)

Compare

SPECIFICATIONS

	U. S. VERTICAL
Table Size	9½" x 36"
Longitudinal Feed	24"
Cross Feed	9¾"
Knee Travel	16½"
Quill Travel	5½"
Dovetail Depth	1¼" x 1½"
Vertical Screw	1⅜" dia.
Weight	1600 lbs.
Table Power Feed	0" - 12" per min. (infinitely variable)

CHECK THESE AGAINST ALL COMPETITION!

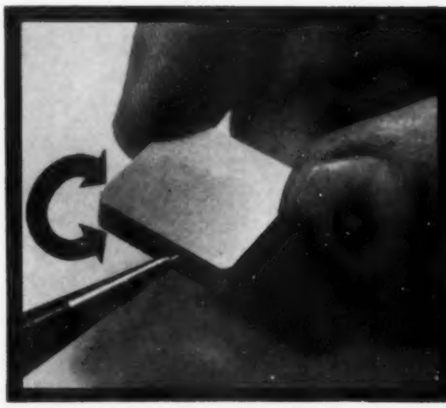
Compare

DELIVERY, too!

... our new plant addition permits us to promise and fulfill prompt deliveries.

THE U·S·Burke MACHINE TOOL DIVISION

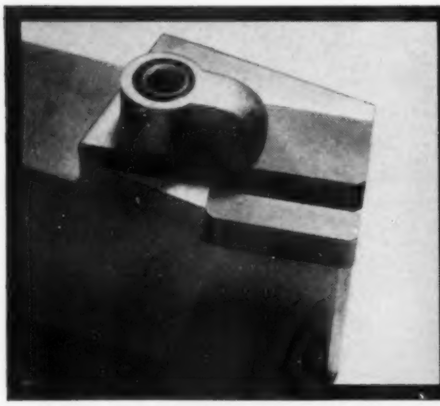
NEW "TURNOVER" INSERTS



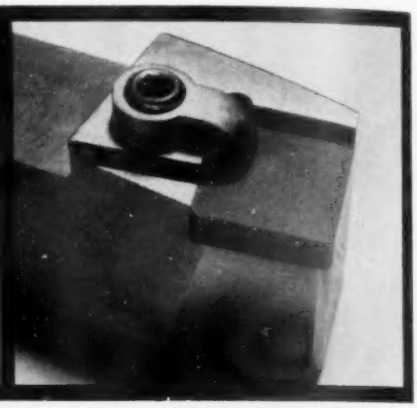
You have twice as many cutting edges on these clamp-on, "turnover" inserts. Use all edges on one side, then turn the insert over and use an equal number on the reverse side.

You can index a new Kendex insert in seconds. Simply loosen the sturdy top clamp and turn the insert to a new cutting edge . . . without disturbing the tool setup.

NEW CHIP CONTROL SYSTEM



These new Kendex Tools have an entirely new system of chip control that completely eliminates expensive chip-breaker grinding.



Clamped carbide chip breakers can be removed when not needed. Clamp has sufficient travel to hold insert without chip breaker.

New Kendex* Tooling has 2 big features

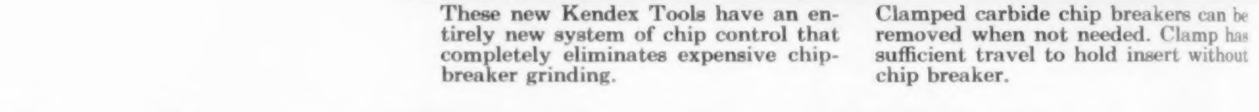
COST COMPARISON

(¾-inch tools required to provide 160 cutting edges)

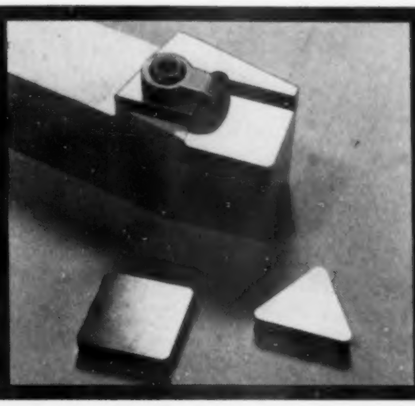
Standard Brazed Tools		Kendex KBR-12	
Cost of 23 tools	$ 44.62	20 inserts	$20.40
Regrind expense**	61.90	1 holder	6.50
Total cost	$106.52	Total cost	$26.90
Cost per edge	66.5¢	Cost per edge	16.8¢
**Six grinds per tool			

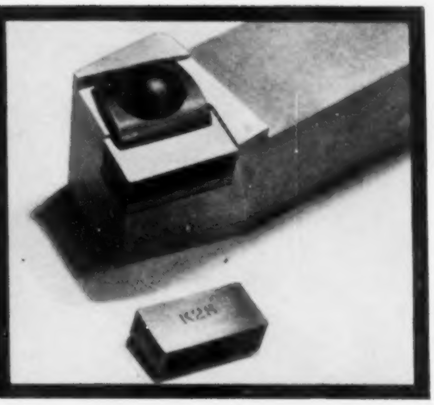
Total Kendex Savings $79.62

*Registered Trademark



MINING, METAL AND WOODWORKING TOOLS WEAR AND HEAT-RESISTANT PARTS ABRASION, CORROSION-RESISTANT

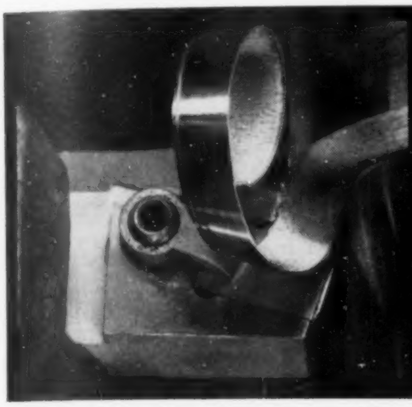


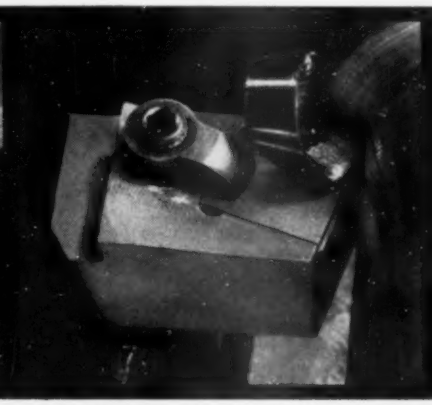


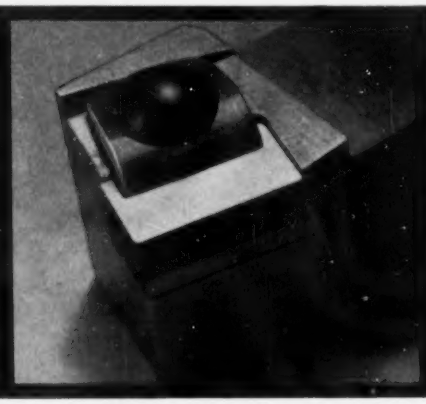
Each replacement insert fits accurately into the rugged, heat-treated shank, with the cutting edge perfectly aligned for use. No complex mechanism to adjust or fail.

For Standard Tools: "Regular" inserts (corner radii, top, and bottom surfaces ground) and "Precision" inserts (all surfaces ground) are available in square and triangular shapes.

For Heavy-Duty Tools: Standard molded blanks ground only on the corner radii for lowest possible cost per cutting edge. These blanks index within plus or minus 0.005 inch.







The carbide chip breakers on these tools have the widest effective range of application of any mechanical chip breakers known.

An indication of their effectiveness can be obtained from the two illustrations above. At left, 0.014 inch feed; at right, 0.036 inch feed—using same tool.

Kendex Heavy-Duty Tools have rigid, spring clamps which serve as chip deflectors. These inexpensive clamps are easily replaced.

to help you cut machining costs

A series of clamp-on, "turnover" inserts and a new system of chip control are helping users of this new Kendex Tooling slash tool cost per cutting edge by completely eliminating expensive grinding operations.

Two tools, the Standard and the Heavy-Duty, are designed to use the new Kendex "turnover" inserts which have cutting edges on not one, but *both* sides. Use twice the number of cutting edges before replacing these cost-cutting, "throw-away" inserts. And, the new top-clamp tool design enables you to index them in less time than ever before.

New Kendex Tooling not only eliminates regrinding of inserts, but the grinding of chip breakers as well. Standard sizes are equipped with replaceable, carbide chip breakers which can be removed, if desired. Heavy-Duty sizes are fitted with rigid, inexpensive spring clamps which serve as chip deflectors.

This combination of new "turnover" inserts and new system of chip control, plus the new top clamp for rapid indexing, is cutting tool costs on all types of machining operations wherever it is used.

See the cost comparison chart (*left*) and judge for yourself. This comparison indicates the *average* cost reduction that users have realized from this new Kendex Tooling. Call your Kennametal representative for a demonstration or write for additional information. KENNAMETAL INC., Latrobe, Pa. A 28

PARTS PERCUSSION AND IMPACT PARTS

INDUSTRY AND

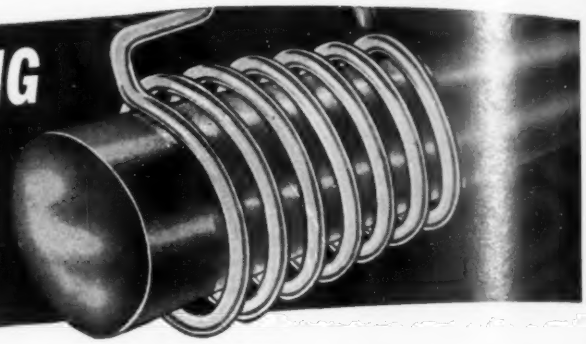
KENNAMETAL

...Partners in Progress

 FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-257

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-1-259

YOU CAN HEAT *ANYTHING*
FROM A NEEDLE . . . TO A TURBINE SHAFT
FASTER and BETTER



BRAZING
Permits widest choice of silver or copper brazing alloys from lowest to highest melting points. Ideal for brazing carbide tips.

HARDENING
Heat localized exactly where wanted at desired temperature. Ideal for gears, cams, bearing surfaces, cutting tools and other areas that are subject to wear.

SOLDERING
Speedily and neatly performs intricate soldering applications with or without the use of preformed rings.

ANNEALING
Ideal for annealing, stress-relieving, normalizing or preheating selected areas.

MELTING
Readily melts quantities of ferrous and non-ferrous metals in either graphite or ceramic crucibles.

WITH **Lepel**

HIGH FREQUENCY
Induction
HEATING UNITS

The Lepel line of induction heating units represents the most advanced thought in the field of electronics as well as the most practical and efficient source of heat yet developed for industrial heating. With a background of half a century of electrical and metallurgical experience, the name Lepel has become the symbol for quality in induction heating equipment embodying the highest standards of engineering achievement, dependable low cost operation and safety.

If you are interested in the application of induction heating you are invited to send samples of the work with specifications of the operations to be performed. Our engineers will process these samples and return the completed job with full data and recommendations without any cost or obligation.

2½ KW INDUCTION HEATING UNIT

30 KW INDUCTION HEATING UNIT

100 KW INDUCTION HEATING UNIT

LEPEL Electronic Tube GENERATORS
1 KW; 2½ KW; 5 KW; 10 KW; 20 KW; 30 KW; 50 KW; 75 KW; 100 KW.

LEPEL Spark Gap Converters
2 KW; 4 KW; 7½ KW; 15 KW; 30 KW.

All Lepel equipment is certified to comply with the requirements of the Federal Communications Commission.

WRITE FOR THE NEW LEPEL CATALOG . . . 36 illustrated pages packed with valuable information on high frequency induction heating.

LEPEL HIGH FREQUENCY LABORATORIES, INC.
55th STREET and 37th AVENUE, WOODSIDE 77, NEW YORK CITY, N. Y.

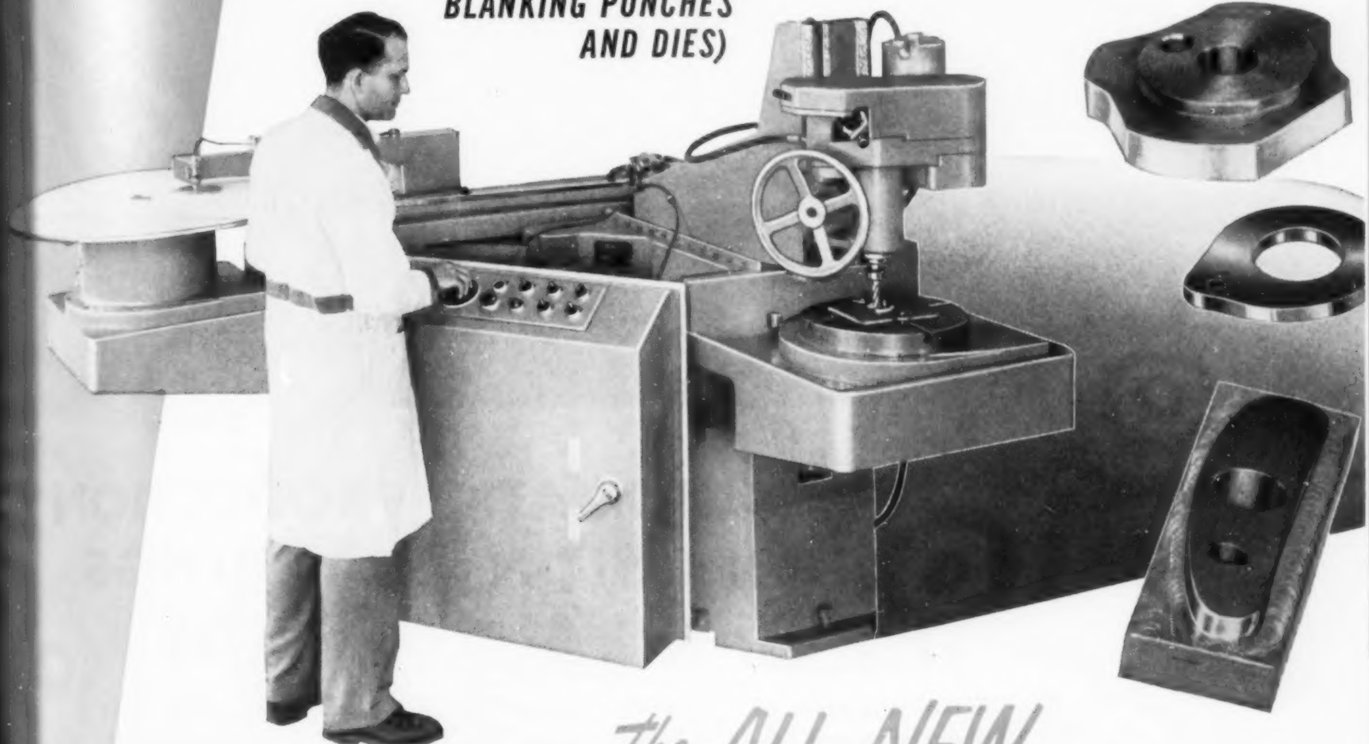
NEW

MILL OR GRIND

EXTERNAL or INTERNAL CONTOURS

(CAMS, TEMPLATES, BLANKING PUNCHES AND DIES)

- DIRECTLY FROM SIMPLE LINE DRAWINGS
- WITH EXTREME ACCURACY
- IN MINUTES INSTEAD OF HOURS
- WITH NON-CONTACTING TRACER CONTROL



the ALL NEW Model 104 electronic CAM and TEMPLATE Machine

Using a new and unique non-contacting tracer control, the Model 104 works direct from simple, large-scale line drawings easily prepared with electrically conductive "ink". The contour of the drawing is reproduced at the milling head at **any reduced** scale, such as 5:1, 10:1, 20:1, or higher. Any errors in the drawing are proportionately reduced, resulting in extreme accuracy of the workpiece. Since neither model nor complex tooling-up is required, production costs are minimized. Built for continuous, heavy-duty operation, the Model 104 provides a wide range of spindle speeds (48 to 11,500 rpm) and ample power to assure efficient milling or grinding of practically any desired metal or alloy.

If you are producing external or internal cams, templates, and blanking punches and dies of irregular, complex shape . . . here are important opportunities for added precision, reduced production time, and cost savings never before possible!

USE THIS COUPON TO SEND FOR COMPLETE INFORMATION TODAY

MANUFACTURED BY THE NEW ENGLAND MACHINE & TOOL COMPANY

Sales . . . and Complete Sales Engineering and Maintenance Service . . . Through

PRATT & WHITNEY

DIVISION NILES-BEMENT-POND COMPANY

WEST HARTFORD 1, CONNECTICUT, U.S.A.

SINCE 1860

First Choice for Accuracy

BRANCH OFFICES IN PRINCIPAL CITIES

MACHINE TOOLS • CUTTING TOOLS • GAGES

PRATT & WHITNEY -- DIV. NILES-BEMENT-POND CO.

16 CHARTER OAK BLVD., WEST HARTFORD 1, CONN.

Please send my free copy of Circular No. 582 fully describing the new Model 104 Cam and Template Machine.

NAME____________________

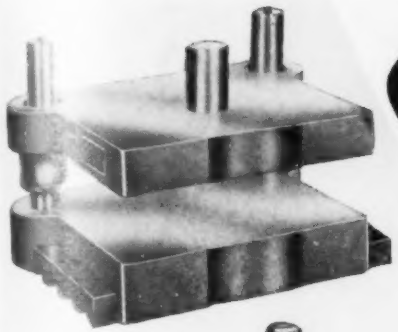
POSITION____________________

COMPANY____________________

CO. ADDRESS____________________

CITY__________ ZONE______ STATE__________

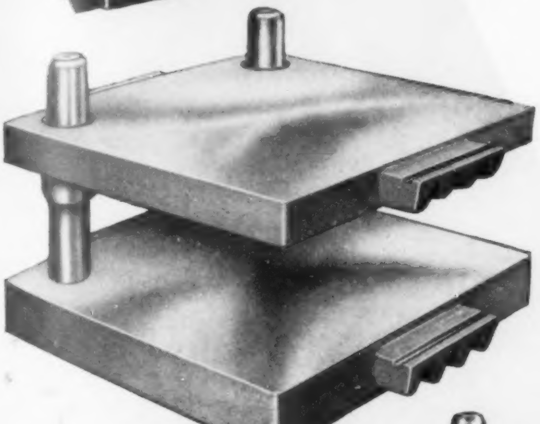
f[illegible] **all** your die set needs . . .



SUPERIOR

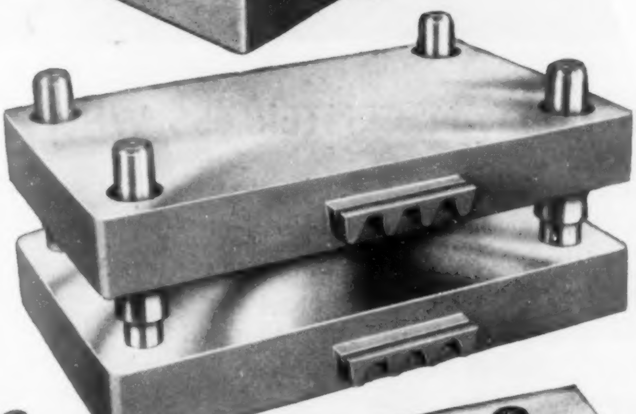
PRECISION ALL-STEEL

DIE SETS



with Exclusive Safety and Handling Features!!!

For 30 years Superior engineers have directed their efforts to improving die set designs both in precision quality and ease of handling. In the process they have pioneered many firsts and today set the standard for specially designed safety features that speed production by eliminating unnecessary handling. Among the exclusive Superior innovations are the Safety Flange, Lock Jaw Lifting Device, and E-Z Lift Sling Chain. Prove to yourself how these unique safety features can speed your production astonishingly, while maintaining highest precision standards.



Send for FREE Catalogue containing helpful data on Superior Die Sets and Die Makers' Supplies.

For Fast Local Service Call these Expert Superior Representatives

- Kalamazoo, Mich. —Phone 5-7988
- Indianapolis, Ind.—BRoadway 5668
- Chicago, Ill.—RAndolph 6-8871
- Dallas, Tex.—Riverside 5138
- Rockford, Ill.—Phone 3-3932
- St. Louis, Mo.—JEfferson 5-1223
- Milwaukee—MItchell 5-6027
- Dayton, Ohio — Hemlock 6209
- Memphis, Tenn.—3-7727
- Cleveland, O.—KEnmore 1-2015
- Eau Claire, Wis.—2-3453
- St. Paul, Minn.—PRior 6485
- Winter Park, Fla.—4-0464
- Boston, Mass.—HUbbard 2-3373

SUPERIOR STEEL PRODUCTS CORP.
2734 S. 19th ST., MILWAUKEE, WIS.

HOW TO BUY CENTERLESS WHEELS

FOR FASTER PRODUCTION AT LOWER COST

... and get "More Use per Dollar"

Look for a rubber bonded wheel that permits both roughing *and* finishing . . . at higher grinding speeds.

To do two jobs efficiently—roughing and finishing—the centerless wheel you buy should have a high grit-carrying bond that will insure maximum metal removal with every pass. A high grit-to-bond ratio produces a fast, free cutting wheel that needs fewer dressings. The rubber bond should also be able to produce desired finishes to required tolerances, even with coarse-grained abrasives. A wheel with these characteristics enables you to do both roughing and finishing operations, simply by controlling the feed rate and the amount of rough stock removed ... without time consuming wheel changes. In addition, if the wheel is strong enough to permit high speed operation, you can realize substantial savings in production time and costs.

Specify the centerless wheels that give you all these features . . . specify Manhattan Rubber Bonded Centerless Wheels.

MANHATTAN CENTERLESS WHEELS

Manhattan Centerless Grinding and Regulating Wheels are custom-made in the abrasive and bond required for your operations. By using Manhattan Centerless Wheels you are assured heavier metal removal per pass, close tolerances and superior finishes . . . a better job, faster—at lower cost. Their greater strength allows grinding speeds up to 8500 sfpm. Manhattan Regulating Wheels are supplied either plain or core-mounted. Manhattan Core Mountings provide substantial wheel savings.

Ask your Manhattan representative to show you how Manhattan Centerless Wheels and other high speed, heavy duty abrasive wheels last much longer . . . give you "More Use per Dollar".

WRITE TO ABRASIVE WHEEL DEPARTMENT
MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

1954 Subject Index of THE TOOL ENGINEER Advertisers

This index of advertisers includes all advertisers who have appeared in THE TOOL ENGINEER during 1954. Advertisements are classified according to the main subject of the advertisement published in a given issue, and not according to the entire line manufactured. Thus, for example, the reader may find all advertisements that had "turning" as a primary subject listed under that heading by name of company and month of appearance. A complete alphabetical index of advertisers was published in the December 1954 issue.

This index is published as a reader service. Although every precaution is taken to assure correct listing, no allowance will be made for error or omission.

MACHINE TOOLS AND ATTACHMENTS

TURNING

American Tool Works Co., The, Jan., Mar., May, July, Sept., Nov.
Axelson Mfg. Co., Feb., Apr., July, Aug., Oct., Dec.
Baird Machine Co., May.
Baker Brothers, Inc., Oct.
Colonial Broach Co., Apr.
Cosa Corp., Apr.
Coulter, James, Machine Co., The, Aug.
Douglas Tool Co., Apr.
Elgin Tool Works, Inc., Mar., May., July, Nov.
Gisholt Machine Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
H. E. B. Machine Tool Co., Jan., Mar., Apr., May, July.
Hardinge Brothers, Inc., Mar., Apr., July, Oct., Nov., Dec.
Hydra-Feed Machine Tool Corp., Nov.
Jones & Lamson Machine Co., Aug.
Kaydon Engineering Corp., The, Oct.
Lehigh Foundries, Inc., Feb., Apr., June, Aug., Sept., Oct., Nov., Dec.
Levin, Louis, & Son, Inc., Aug., Oct., Dec.
Lincoln Industries Inc., Sept.
Logan Engineering Co., Apr., Dec.
M. B. I. Export & Import, Ltd., Feb., Apr., June, Aug., Oct., Nov.
Master Mfg. Co., Apr.
Monarch Machine Tool Co., Mar., May, Sept., Nov.
Morey Machinery Co., Inc., Feb.
National Automatic Tool Co., Inc., Nov.
Nebel Machine Tool Co., The, Apr.
Neise, Karl A., Apr.
New Britain Machine Co., The, Jan.
Potter & Johnston Co., Jan., Mar., Sept.
Pratt & Whitney, May, July.
R and L Tools, Inc., Jan., Aug.
Seneca Falls Machine Co., Feb., Apr., June, Aug., Oct., Dec.
Sheldon Machine Co., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Sidney Machine Tool Co., Jan., Mar., May, July, Sept., Nov.
South Bend Lathe Works, Jan., Mar., May, Sept., Oct., Nov.
Sundstrand Machine Tool Co., July.
Wade Tool Co., Aug., Dec.
Warner & Swasey, Jan., Mar., Apr., May, June.
Wickes Brothers, Nov., Dec.

BORING

Baker Brothers, Inc., Aug.
Barnes, W. F. & John, Co., Apr., Aug., Oct.
Black Drill Co., Oct.
Bodine Corp., The, Apr.
Bullard Company, The, Apr.
Carlton Machine Tool Co., The, Apr.
Chandler Tool Co., Apr.
Cleveland Tapping Machine Co., The, Sept.
Cosa Corp., Apr.
Cross Company, The, June.
Davis Boring Tool Div., Jan., Apr., June, Sept., Nov.
DeVlieg Machine Co., Feb., Apr., June, Aug., Oct.
DeVlieg Microbore Co., Jan., Mar., May, July, Sept.
Douglas Tool Co., Apr.
Ex-Cell-O Corp., May, July, Sept., Oct., Dec.
Foote-Burt Co., The, Mar., Aug., Sept.
Gorton, George, Machine Co., Nov.
Greenlee Bros. & Co., Oct.
Heald Machine Co., Jan., Feb., Mar., Apr., June, Aug., Sept., Nov.
Hirschmann, Carl, Co., Inc., May.
Hutchinson, William T., Co., Oct.
Jahn, B. Mfg. Co., The, Mar., Apr., May, June, Sept.
Kingsbury Machine Tool Corp., Apr.
Knight, W. B. Machinery Co., Aug., Oct., Dec.
Lehmann Boring Tool, Feb., June, Aug.
Lucas Machine Division, June.
M. B. I. Export & Import, Ltd., Jan., Mar., Apr., May, July, Sept., Oct., Dec.
Machine Products Corp., Feb., Apr.
Mallory, P. R., & Co., The, Nov.
Marac Machinery Corp., Apr.
Maxwell Co., The, Oct.
Moline Tool Co., Feb.
Moore Special Tool Co., Feb., Apr., Sept., Nov.
Morris Machine Tool Co., Oct.
National Automatic Tool Co., Nov.
Neise, Karl A., Apr.
New Britain Machine Co., The, Sept., Oct., Nov., Dec.
Pioneer Tool & Eng. Co., Jan.
Pratt & Whitney, Feb.
Precision Tool & Mfg. Co. of Ill., Nov., Dec.
Robbins, Omer E., Co., Aug.
Simplex Machine Tool Corp., Jan., Mar., May, July, Sept., Nov.
Snyder Tool & Engineering Co., Sept.
Vulcan Tool Co., July.

PLANING AND SHAPING

Cincinnati Shaper Co., Jan., Apr., July.

DRILLING

Ace Drill Bushing Co., Inc., Oct.
Acme Industrial Co., Oct.
American Tool Works Co., The, Feb., Apr., June, Aug., Oct., Dec.
Baker Brothers, Inc., Feb., Aug., Oct., Dec.
Barnes, W. F. & John, Co., Apr., Aug., Oct.
Baush Machine Tool Co., Aug.
Bellows Co., The, Jan., Apr., Sept.
Black Drill Co., Feb.
Bodine Corp., The, Feb., June, Aug., Oct., Dec.
Boice-Crane Co., Feb., May.
Boyar-Schultz Corp., Oct.
Buhr Machine Tool Co., Feb., June, Sept., Nov.
Burg Tool Mfg. Co., Feb., Apr.
Carlton Machine Tool Co., The, Jan., Oct., Nov., Dec.
Colonial Bushings, Inc., Oct.
Commander Mfg. Co., Mar.
Cosa Corp., Apr.
Cross Co., Inc., June.
Deakin, J. Arthur, & Son, Apr.
Detroit Power Screwdriver Co., Nov.
Douglas Tool Co., Apr.
Drillunit, Inc., Feb., Apr., June, Aug.
Dumore Company, The, Jan., Mar., Apr., May, July, Oct., Dec.
Edlund Machinery Co., Apr., Aug., Dec.
Erickson Tool Co., Apr., Aug., Dec.
Errington Mechanical Laboratory, Inc., Apr., June, Sept.
Ettco Tool Co., Inc., Feb., Apr.
Foote-Burt Co., The, Mar., Apr., Aug., Sept., Oct., Nov.
Gorton, George, Machine Co., Feb.
Govro-Nelson Co., Nov.
Greenlee Brothers & Co., Oct.
Hartford Special Machinery Co., The, Apr., June, July, Sept.
Hi-Shear Rivet Tool Co., The, Oct.
High Speed Hammer Co., Apr.
Hillyer Instrument Co., Inc., Apr.
Howe & Fant, Inc., Apr., June.
Kearney & Trecker Corp., Apr.
Kingsbury Machine Tool Co., Oct.
Lamina Dies & Tools, Inc., Oct.
M. B. I. Export & Import, Ltd., Apr., Oct.
Magna Engineering Corp., Mar., Apr., Aug., Sept.
Marac Machinery Corp., Apr.
Meyers, W. F. Co., Inc., Oct.
Michigan Drill Head Co., Aug., Oct., Dec.
Moline Tool Co., Apr., June, Oct., Dec.
Morris Machine Tool Co., July, Aug., Sept., Nov., Dec.
National Automatic Tool Co., Inc., Nov., Dec.
New Britain Machine Co., The, Sept.
Precision Tool & Mfg. Co., of Ill., Sept.
Rehnberg-Jacobson Mfg. Co., Nov., Dec.
Robbins, Omer E., Co., Aug.
Rockwell Mfg. Co., Mar., Apr., May, July, Sept., Nov., Dec.
Snow Mfg. Co., Jan., Mar., May, July, Sept.
Snyder Tool & Engineering Co., Mar., Sept.
Standard Machine & Tool Co., Ltd., Jan., Feb.
Walker-Turner Division, Nov.
U. S. Drill Head Co., Jan., Feb., Mar., April, May, June, Sept., Oct., Nov.
Zagar Tool, Inc., Jan., Mar., Apr., May.

GEAR CUTTING & FINISHING

Barber-Colman Co., Nov.
Cosa Corp., July.
Fellows Gear Shaper Co., Jan., Feb., Mar., Apr., May, June, Aug., Sept., Oct., Nov., Dec.
Gear Grinding Machine Co., The, Apr.
Lees-Bradner Co., Mar., May, June, Sept., Nov.
Michigan Tool Co., Mar., June, Oct.
Modern Industrial Engineering Co., Apr., June.
National Broach & Machine Co., Feb., Mar., May, July, Sept.
Russell, Holbrook & Henderson, Inc., Jan., Mar., Apr., May, July, Aug., Sept., Oct., Dec.
Sheffield Corp., The, Oct.
Thompson Grinder Co., Dec.

TAPPING & THREADING

Automatic Methods, Inc., Jan., Feb., Mar., Apr., June.
Baker Brothers, Inc., Oct.
Baush Machine Tool Co., Jan.
Black Drill Co., Inc., Oct.
Bodine Corp., The, Apr., June, Aug., Oct., Dec.
Boyar-Schultz Corp., Aug.
Buhr Machine Tool Co., Nov.
Cleveland Tapping Machine Co., The, May, June, July, Aug., Sept., Oct., Nov., Dec.
Commander Mfg. Co., Apr.
Coulter, James, Machine Co., Mar., June, Nov.
Cross Co., The, June.
Douglas Tool Co., Apr.
Eastern Machine Screw Corp., The, Feb., Apr., May.
Edlund Machinery Co., Apr., Dec.
Elgin Tool Works, Inc., July.
Erickson Tool Co., Aug., Dec.
Errington Mechanical Laboratory, Inc., Apr., June, Sept.
Ettco Tool Co., Inc., Mar., Sept., Dec.
Foote-Burt Co., The, Mar., Apr., Sept., Nov.
Greenfield Tap & Die Corp., Mar., Apr.
Greenlee Bros. & Co., Oct.
Hanson-Whitney Co., May.
Hardinge Brothers, Inc., Apr., Dec.
Hartford Special Machinery Co., The, Mar., Apr., June, Nov.
Jarvis, Charles L., Co., Mar., Apr., May.
Jones & Lamson Machine Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Kaufman Mfg. Co., Apr., June, Sept., Oct., Nov.
Kingsbury Machine Tool Corp., Feb., Apr., Oct.
Landis Machine Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Dec.
Lees-Bradner Co., July.
Magna Engineering Corp., Apr.
Morey Machinery Co., Inc., Jan.
Morris Machine Tool Co., Sept., Oct.
Morse Twist Drill & Machine Co., Nov.
National Automatic Tool Co., Inc., Nov., Dec.
R and L Tools, Inc., Oct., Dec.
Reed Rolled Thread Die Co., Feb., Apr., May, Sept., Oct., Nov.
Rehnberg-Jacobson Co., Dec.
Salvo Tool & Engineering Co., Apr.
Snow Mfg. Co., Jan., Mar., May, July, Sept.
Wade Tool Co., Feb., Apr., June, Oct., Dec.
Wickes Brothers, Sept., Oct.

BROACHING

American Broach & Machine Co., Jan., Feb., Mar., Apr., May, June, Aug., Sept., Oct., Nov., Dec.
Colonial Broach Co., Feb., June, Aug., Dec.
Detroit Broach Co., Dec.
East Shore Machine Products Co., The, Apr.
Fellows Gear Shaper Co., July.
Foote-Burt Co., The, Jan., Feb., Mar., May, June, July, Aug., Dec.
Kingsbury Machine Tool Co., Apr.
Lapointe Machine Tool Co., The Jan., Feb., Mar., Apr., May, June, Sept., Oct., Nov. Dec.
National Broach & Machine Co., Jan., Apr., June, Aug., Oct., Nov., Dec.

MILLING

Barker Engineering Co., Oct., Dec.
Barnes, W. F. & John, Co., Apr.
Bodine Corp., The, Aug.
Brown & Sharpe Mfg. Co., Mar., July.
Bullard Co., The, Apr.
Cosa Corp., Jan.
DeVlieg Microbore Co., May.
Elgin Tool Works, Inc., Mar., Apr., July.
Erickson Tool Co., Apr., Aug., Dec.
Fray Machine Tool Co., Apr., June, Sept.
Gorton, George, Machine Co., June, Nov.
Graham Machine Tool Co., Apr.
Hardinge Brothers, Inc., July.
Ingersoll Milling Machine Co., The, Mar.
Kearney & Trecker Corp., Jan., Feb., Mar., Apr., June, July, Aug., Oct., Dec.
Knight, W. B., Machinery Co., Feb., Aug., Dec.
Marac Machinery Corp., Apr.
Master Mfg. Co., Apr.
New Britain Machine Co., The, Sept.
Pope Machinery Corp., Mar., June.
Pratt & Whitney, June, Aug., Nov.
Rehnberg-Jacobson Co., Nov.
Rogers Machine Works, Jan.
Snyder Tool & Engineering Co., Feb., Sept.
Standard Machine & Tool Co., Ltd., Jan., Feb.
Sundstrand Machine Tool Co., Jan., Mar., May, Sept.
U. S. Burke Machine Tool Div., Apr., June, Oct., Nov.

GRINDING, HONING, LAPPING, BURNISHING

Arter Grinding Machine Co., Feb., Apr., June, Aug., Oct., Dec.
Barber-Colman Co., Mar.
Besly-Welles Corp., Mar., Apr., June.
Blake, Edward, Co., Mar., July, Sept.
Boyar-Schultz Corp., Apr.
Brown & Sharpe Mfg. Co., Jan.
Bullard Co., The, Apr.
Consolidated Machine Tool Corp., Feb., Apr., June, Aug., Oct., Dec.
Cosa Corp., Apr. May, Nov.
Crane Packing Co., Feb., Apr., May, July, Sept., Nov.
Crystal Lake Grinder Co., Apr., May.
DoAll Co., Apr.
Dumore Co., The, Feb., June.
Ex-Cell-O Corp., Feb., Mar.
Fosdick Machine Tool Co., The, Sept.
Foster Engineering Co., July, Sept.
Gisholt Machine Co., Feb., Mar., Apr., June, July, Nov.
Hammond Machinery Builders, Inc., Feb., Apr., Sept., Nov.
Heald Machine Co., Apr., May, July, Aug., Sept., Oct.
Hisey-Wolf Machine Co., Jan., Mar.
Ingersoll Milling Machine Co., Jan.
Jarvis, Charles L., Co., June
Jones & Lamson Machine Co., May, Dec.
Kaydon Engineering Corp., The, Feb., Apr., June, Aug., Oct., Dec.
Last Word Sales Co., June
Lee, K. O., Co., Jan., Feb., Mar., Apr.
M. B. I. Export & Import, Ltd., Apr.
Mercury Engineering Co., Jan.
Micromatic Hone Corp., Jan., Mar., May, July, Sept., Nov.
Norton Co., Jan., Mar., May, June, Aug., Sept., Nov., Dec.
Parker-Majestic, Inc., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Pope Machinery Corp., Jan., Feb., Mar., Apr., May, Sept., Oct., Nov.
Pratt & Whitney, Apr.
Reid Brothers Co., Inc., Feb., Apr., June, Dec.
Robbins, Omer E., Co., Aug.
Standard Electrical Tool Co., The, Feb., Apr., June, Oct., Nov.
Taft-Peirce Mfg. Co., The, Apr.
Thompson Grinder Co., Feb., Apr., June, Oct.
Vulcan Tool Co., Jan., Feb., Apr., June, July, Aug., Sept., Oct., Nov., Dec.

CUTOFF AND FILING

American Chain & Cable Co., Feb., June, Aug.
Armstrong-Blum Mfg. Co., Mar., Dec.
DoAll Co., June, Sept., Oct., Nov., Dec.
Gorton, George, Machine Co., Sept.
Grob, Inc., Apr.
Kling Bros. Engineering Works, Jan., July.
Rockwell Mfg. Co., Feb.
Stone Machinery Co., Inc., Apr.
Walker-Turner Division, Apr.

TRANSFER MACHINES

Baker Brothers, Inc., Apr., June.
Barnes, W. F. & John, Co., June, Aug., Dec.
Baush Machine Tool Co., Dec.
Buhr Machine Tool Co., Apr., Aug.
Cross Co., The, Feb., Apr., Aug., Oct., Dec.
Greenlee Bros. & Co., Dec.
Kearney & Trecker Corp., Sept.
National Automatic Tool Co., Inc., June.
Norgren, C. A., Co., Oct.
Peerless Production Co., Apr., June.
Snyder Tool & Engineering Co., May, June, July, Aug., Oct., Nov., Dec.

AUTOMATICS

Baird Machine Co., Jan., Nov.
Barnes, W. F. & John, Co., Apr., Aug.
Boyar-Schultz Corp., Mar.
Brown & Sharpe Mfg. Co., Sept.
Cone Automatic Machine Co., Jan.
Detterbeck, Geo. L., Co., Feb., Apr., June.
Elgin Tool Works, Inc., Mar., Sept.
Gear Grinding Machine Co., The, Nov.
Greenlee Bros. & Co., Feb., Apr., Aug.
Guthery Machine Tool Co., Jan., Feb., Apr.
Hudson Automatic Machine & Tool Co., Apr.
Hydra-Feed Machine Tool Corp., Nov.
Landis Machine Co., Nov.
National Automatic Tool Co., Inc., Mar., June, Aug., Oct.
New Britain Machine Co., The, Feb., Mar., Apr., May, July, Aug.
Potter & Johnston Co., Nov.
R and L Tools, Inc., Feb., Mar., May, June, July, Sept., Nov.
Russell, Holbrook & Henderson Inc., Feb., June, Nov.
Snyder Tool & Engineering Co., Jan.
Sundstrand Machine Tool Co., Nov.
Swanson Tool & Machine Products, Inc., Apr., June, Sept.
Warner & Swasey, Feb., July.

MACHINE TOOLS AND ACCESSORIES

WORKHOLDERS

Accurate Bushing Co., Nov.
Ace Drill Bushing Co., Inc., Dec.
Acme Tool Co., Sept.
American Machine & Foundry Co., Mar., Apr., July.
Apex Tool & Cutter Co., Apr.
Armstrong Bros. Mfg. Co., Apr., Sept.
Aviation Developments, Inc., Apr.
Balas Benco Collet Mfg. Co., Jan., Feb., Mar., May, June, July, Nov., Dec.
Bellows Co., The, Jan.
Brown & Sharpe Mfg. Co., Nov.
Buck Tool Company, Jan., Mar., May, July, Nov.
Cardinal Machine Co., Nov.
Concentric Tool Corp., Sept., Nov.
Crodian & Co., Apr.
Cushman Chuck Co., Feb., Apr., June, Aug., Oct., Dec.
Dakon Tool & Machine Co., Inc., Apr.
Danly Machine Specialties, Inc., July.
DeWitt Equipment Co., Apr.
Detroit Reamer & Tool Co., Oct.
Detroit Stamping Co., Jan., Mar., Apr., May, July, Sept., Nov.
Erickson Tool Co., June, Sept., Oct., Nov.
Fallon Industries, Inc., Apr.
Galland-Henning Mfg. Co., Apr.
General Roto Co., Apr.
Glenzer, J. C., Co., Jan., Dec.
Hammond Machinery Builders, Inc., June.
Hardinge Brothers, Inc., Jan., Feb., Apr., May, June, July, Aug.
Heinrich Tools, Inc., Jan., Mar., Apr., Oct.
Hi-Shear Rivet Tool Co., The, June.
Horton Chuck, Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct.
Ideal Industries, Inc., Feb., Mar., Apr., May, Sept., Nov.
Ingersoll Milling Machine Co., The, Oct.
J & S Tool Co., Inc., Feb., Mar.
Jacobs Mfg. Co., June.
Lapeer Mfg. Co., Apr., June, Aug., Oct., Dec.
Lassy Tool Co., Sept., Nov.
Last Word Sales Co., Feb.
Lodding, Inc., Jan., Mar., Apr., June, Sept., Nov.
Logansport Machine Co., Inc., Apr.
Machine Products Corp., June.
Magna Engineering Co., Apr.
Melin Tool Co., Inc., June, Oct.
Modern Tool Works Division, May.
Morton Machine Works, Jan., Feb., Mar., Apr., May, June, July, Sept., Nov.
Procunier Safety Chuck Co., Apr.
Ready Tool Co., Feb., Apr., June, Aug., Dec.
Robbins, Omer E., Co., Apr., Oct.
S-P Mfg. Corp., June.
Scully-Jones & Co., Apr.
Sheffer Collet Co., Feb.
Skinner Chuck Co., The, Jan., Apr., Oct.
Standard Parts Co., July, Aug., Sept., Oct., Nov., Dec.
Sutton Tool Co., Feb., Apr., June, Oct.
Swartz Tool Co., Jan.
Taft-Peirce Mfg. Co., The, Apr.
Techno Products, Inc., Apr.
Universal Engineering Co., Mar.
V & O Press Co., The, Oct.
Vlier Eng. Co., Jan.
Wahlstrom Float-Lock Sales Division, Oct., Dec.
Walker, O. S., Co., Inc., Jan., Mar., Apr., July, Sept., Nov.
West Point Mfg. Co., Apr., Oct., Dec.
Western Tool & Mfg. Co., Jan.
Whiton Machine Co., Feb., Apr., June.
Wilton Tool Company, Feb., Mar., Apr., June, July, Sept.
Wolverine Tool Co., Apr.
Woodworth, N. A., Co., Feb., Mar., Apr., May, Oct.
Zagar Tool, Inc., Feb., Apr., June, July, Aug., Sept., Oct., Nov., Dec.
Ziegler, W. M., Tool Co., Apr.

TOOLHOLDER AND GUIDE

Accurate Bushing Co., Mar.
Ace Drill Bushing Co., Inc., Aug.
Acme Industrial Co., Apr., June.
Acme Tool Co., Jan., Mar.
American Drill Bushing Co., Mar., Apr., May, July, Sept., Nov.
Armstrong Bros. Mfg. Co., Jan., Mar., Oct., Nov.
Atrax Co., The, May.
Beaver Tool & Engineering Corp., Feb., Apr., June, Aug., Oct., Dec.
Balas/Benco Collet Mfg. Co., Aug.
Chandler Tool Company, Jan., May, June, July.
Colonial Bushings, Inc., Feb., Mar., Apr., May, June, July, Aug., Sept., Nov., Dec.
Davis Boring Tool Division, Aug.
Douglas Tool Co., Apr.
E & E Engineering, Inc., Dec.
Erickson Tool Co., Feb., July.
Ex-Cell-O Corp., Aug.
Fallon Industries, Inc., Apr.
Gatco Rotary Bushing Co., Jan., Mar., May, July, Sept., Nov.
Glenzer, J. C., Co., Jan., Mar., Oct.
Heald Machine Co., Dec.
Hi-Shear Rivet Tool Co., The, Feb.
Jacobs Mfg. Co., Sept., Nov.
Jergens, J. G., Co., July.
Jones & Lamson Machine Co., May.
Kennametal, Inc., Apr.
Lamina Dies & Tools, Inc., Feb., Apr., June, Aug., Dec.
Last Word Sales Co., Feb., Apr., June.
Lee, K. O., Co., May, June, July, Aug., Sept., Oct., Nov., Dec.
Magna Driver Corp., Mar., May, July, Sept., Nov.
Mallory, P. R., & Co., Inc., Oct.
Maxwell Co., The, Apr.
Meyers, W. F., Co., Jan., Mar., May, July, Sept., Dec.
Modern Tool Works Division, Mar., July, Sept., Nov.
National Twist Drill & Tool Co., July.
Newcomer Products, Inc., Aug., Oct., Nov.
Portage Double-Quick Tool Co., Feb., Apr., Aug.
Pratt & Whitney, Aug.
Procunier Safety Chuck Co., Mar.
R and L Tools, Inc., Apr.
Scully-Jones & Co., Feb., June, Aug., Oct., Dec.
Siewek Tool Co., May.
Standard Electrical Tool Co., The, Aug.
Sturdy Broaching Co., Mar., June, Sept., Dec.

Swanson Tool & Machine Products, Inc., Mar.
Universal Engineering Co., Jan., Mar., May, July, Sept., Nov.
Up-To-Date Tool Co., Nov.
Vascoloy-Ramet Mfg. Corp., Mar., Apr., May, July, Aug., Sept.
Wahlstrom Float-Lock Sales Division, Aug.
Waldes Kohinoor, Inc., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Wesson Co., Jan., July.
Western Tool & Mfg. Co., Mar., May, July.
Ziegler, W. M., Tool Co., Jan., Feb., Mar., May, June, July, Aug., Sept., Oct., Nov., Dec.

STOCK FEEDS

Balas/Erickson Collet Mfg. Co., Mar., Apr., Sept., Oct.
Bellows Co., The, Jan., Mar.
Benchmaster Mfg. Co., Oct., Dec.
Cross Co., The, Sept., Nov.
Detroit Power Screwdriver Co., Jan., Feb., Mar., May, July, Sept., Nov.
Dickerman, H. E., Mfg., Co., Jan., Mar., Apr., May, Sept., Nov.
Greenlee Bros. & Co., June.
Hapman Conveyors, Inc., Mar.
Hardinge Brothers, Inc., Jan., Feb., Apr., May, June, Sept.
Lipe-Rollway, Inc., Feb., Apr., July, Aug., Oct., Nov.
Littell, F. J., Machine Co., Feb., Apr., June, Oct., Dec.
McKay Machine Co., The, Apr.
Nilson, A. H., Machine Co., The, Apr., Nov.
Pneuma-Draulic Co., Apr., Oct.
Schmidt, Geo. T., Co., Jan., Mar.
Sutton Tool Company, June.
Syntron Co., Jan., Mar., Apr., July, Sept., Nov.
Tomkins-Johnson Co., June.
U. S. Tool Co., The, Apr., Oct., Dec.

CUTTERS (INCL. BROACHES), DRILLS, REAMERS, COUNTERBORES, CUT-OFF TOOLS, ETC.

Adamas Carbide Corp., Feb., Mar., Apr., May, June, July, Aug.
Alina Corp., Oct.
Allegheny Ludlum Steel Corp., Feb., Apr., June.
American Broach & Machine Co., May, July, Aug.
Apex Tool & Cutter Co., Jan., Apr., June, Aug., Oct., Dec.
Armour & Co., May.
Armstrong-Blum Mfg. Co., Jan., Feb., Apr., May, June, July, Aug., Sept., Oct., Nov.
Arrow Tool & Reamer Co., Mar., Apr.
Atrax Co., The, Jan., Mar., July, Sept., Nov.
B-M-S Carbide Specialties, Inc., Oct.
Barber-Colman Co., Jan., May, July, Sept.
Barnes, W. O., Co., Inc., Jan., Apr., June.
Barnes Drill Co., Apr.
Black Drill Co., Apr., Aug., Dec.
Brown & Sharpe Mfg. Co., Mar., July.
Buol Machine Co., Jan., Mar.
Butterfield Division, Union Twist Drill Co., Oct., Nov.
Circular Tool Co., The, Feb., Apr., June, July, Sept., Nov.
Cleveland Cutter & Reamer Co., Apr.
Cleveland Twist Drill Co., Feb., Apr., June, Aug., Oct., Dec.
Colonial Broach Co., Oct.
Connecticut Broach & Machine Co., Jan., Mar., May.
Continental Tool Works Division, Jan., June, Sept., Oct.
DeVlieg Machine Co., Dec.
DeVlieg Microbore Co., Nov.
Detroit Broach Company, Dec.
Detroit Reamer & Tool Co., Feb., Apr., June, Aug., Dec.
Detterbeck, Geo. L., Co., Aug., Oct., Dec.
DoAll Co., Apr.
duMont Corp., The, Jan., Apr.
Eclipse Counterbore Co., Jan., Mar., Apr., June, Aug., Sept., Dec.
Falcon Tool Co., Mar., May, July.
Firth-Sterling, Inc., Apr., Nov.
Fuller Tool Co., Feb., Apr., June.
Gairing Tool Co., Jan., Mar., Apr., June, Aug., Oct., Dec.
Gammons-Hoaglund Co., Jan., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Gay-Lee Co., Apr.
Genesee Mfg. Co., Apr., June, Sept., Oct., Dec.
Gorham Tool Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Greenfield Tap & Die Corp., May, Aug., Dec.
Grobet File Company of America, Jan., Feb., Mar., Apr., May, June, July, Aug., Sept.
Haynes Stellite Co., Feb., July, Oct.
Illinois Tool Works, Mar., Apr., June.
Ingersoll Milling Machine Co., The, Apr., June, Sept.
Jarvis, Charles L., Co., Feb., June.
Kennametal, Inc., Jan., Feb., Mar., May, June, July, Aug., Sept., Oct., Nov., Dec.
Lavallee & Ide, Inc., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Lehmann Boring Tool, Apr.
Levin, Louis, & Son, Inc., Sept., Nov.
Lovejoy Tool Co., Inc., Feb., Apr., June, Aug., Oct., Dec.
Mallory, P. R., & Co., Inc., Dec.
Maxwell Co., The, Jan.
Melin Tool Co., Inc., Apr., Aug., Dec.
Metal Carbides Corp., Jan., Feb., Mar., May, June, July, Aug., Oct.
Meyers, W. F., Co., Feb., Apr., June, Aug., Nov.
Milne, A., & Co., July.
Moline Tool Co., Aug.
Morse Twist Drill & Machine Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Dec.
Motch & Merryweather Machinery Co., The, Jan., Feb., Mar., Apr., May, June, July, Aug., Nov.
National File Company, Oct.
National Tool Co., Jan., Mar., Apr., July, Sept., Nov.
National Tool Salvage Co., Apr.
National Twist Drill & Tool Co., Feb., Mar., Apr., June, Aug., Sept., Oct., Nov., Dec.
Nelco Tool Co., Inc., Jan., Feb., Apr., May, June, Oct., Nov.
Newcomer Products, Inc., Feb., Apr., Nov.
Nobur Mfg. Co., Apr., June, Aug., Oct., Dec.
NuTangs, Inc., Jan., Feb., Mar., Apr., May.
O. K. Tool Co., Inc., The, Feb., Mar., Apr., Aug., Oct., Dec.
Ohio Knife Co., The, Jan., Nov.
Pratt & Whitney, Mar., Apr., June, July, Sept., Oct., Nov.
Ruthman Machinery Co., The, May.
Sandvik Steel Corp., Jan., May, Sept.
Severance Tool Industries, Inc., Jan., Feb., Mar., Apr., June, Sept., Nov.
Simonds Saw & Steel Co., Jan., Feb., Apr., May, Sept.
Smit, Anton, & Co., Inc., Jan.
Standard Tool Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Staples Tool Co., Feb., Mar., May, July, Sept., Nov.
Super Tool Co., Jan., Mar., Apr., May, Sept.
Threadwell Tap & Die Co., Nov.
Tomkins-Johnson Co., Feb., Mar., Dec.
Union Twist Drill Co., Feb., Mar., Apr., May, Sept., Oct., Nov., Dec.
Vascoloy-Ramet Mfg. Corp., June, Aug., Oct., Nov., Dec.
Viking Tool Co., Inc., Apr.
Waldes Kohinoor, Inc., Feb., May, Aug., Sept.
Waukesha Tool Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Wesson Co., Jan., Mar., May, Aug., Dec.
Wesson Metal Corp., Feb., Apr., June, Sept., Oct., Nov.
Winter Brothers, Jan., May.
Woodson Tool Co., Mar., June, Sept., Dec.

GRINDING WHEELS AND DRESSERS; ABRASIVES, ABRASIVE BELTS, AND DISCS

Ace Abrasive Laboratories, Sept.
Allison Co., The, Apr.
American Chain & Cable Co., Oct.
American Coldset Corp., Apr.
Armour & Co., Jan., Feb., Apr., June, July, Aug., Sept.
Bay State Abrasive Products Co., Feb., Apr., July, Sept., Oct., Nov.
Behr-Manning Corp., Jan., Apr., June, Sept.
Coastal Abrasives Co., Jan.
Cro-Plate Co., Inc., The, June.
Diamond Tool Research Co., Feb.
Elox Corporation of Michigan, Oct.
Ennis Equipment Co., Feb., Apr., June, Sept., Oct., Dec.
Industrial Diamond Association of America, Jan., Mar., May.
J & S Tool Co., Inc., Jan., Apr., May, June, July.
Last Word Sales Co., June.
Macklin Co., Apr.
Norton Company, Jan., Feb., Mar., Apr., June, July, Aug., Sept., Oct., Nov., Dec.
Precision Diamond Tool Co., Apr.
Raybestos-Manhattan Inc., Jan., Mar., May, June, Sept., Nov., Dec.
Simonds Abrasive Co., Feb., Apr., May, Sept., Nov.
Smit, Anton, & Co., Inc., Jan., Apr., Dec.
Smit, J. K., & Son, Feb., Apr., June, Aug., Oct., Dec.
Wilson Mechanical Instrument Division, Mar.

TAPS AND DIES

Bath, John, Co., Inc., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Dec.
Bay State Tap & Die Co., Mar., Apr., May, July, Sept., Nov.
Besly-Welles Corp., Jan., Feb., May, Sept., Oct., Nov.
Blake, Edward, Co., Nov.
Butterfield Division, Apr.
Card, S. W., Division, Feb., Apr., May, Sept., Oct., Nov.
Detroit Tap & Tool Co., Mar., May.
Ex-Cell-O Corp., Apr.
Geometric Tool Company Division, June.
Greenfield Tap & Die Corp., Feb., Oct.
Jarvis, Charles L., Co., Mar., Apr., May.
Kaufman Mfg. Co., Mar.
Morse Twist Drill & Machine Co., Jan., Feb., Mar., Apr., May, July, Aug., Sept., Oct., Nov.
National Twist Drill & Tool Co., Jan., May.
Pratt & Whitney, June, Aug., Nov., Dec.
Reiff & Nestor, Inc., June.
Standard Tool Co., Apr., Sept., Oct., Nov., Dec.
Threadwell Tap & Die Co., Jan., Mar., Apr., May, July, Sept.
Winter Brothers, Feb., Mar., Apr., June, July, Aug., Sept., Oct., Nov., Dec.

PUNCHES AND DIES

Accurate Bushing Co., July.
Acme Industrial Co., Sept.
Adamas Carbide Corp., Mar., July.
Allen Mfg. Co., Oct.
Allied Products Corp., Jan., Feb., Mar., Apr., May, July, Aug.
B-M-S Carbide Specialties, Inc., May, Oct.
Barry, Corp., The, Aug.
Baumbach, E. A. Mfg. Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept.
Carboloy, Feb.
Danly Machine Specialties, Inc., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Danneman Die Set Corp., Apr.
Detroit Die Set Corp., Feb., Apr., June, Aug., Oct., Dec.
Haddon Tool & Mfg. Co., Apr.
Jahn, B., Mfg. Co., The, Jan., Feb., Oct., Nov., Dec.
Lempco Products, Inc., Oct., Nov., Dec.
Pivot Punch & Die Co., Apr., June.
Porter Precision Products, Jan., Feb., Mar., Apr.
Producto Machine Co., The, Feb., Apr., June, Aug., Oct., Dec.
Rezolin, Inc., Sept.
Richard Brothers Punch Division, June, Sept., Nov.
Ring Punch & Die Co., Jan., Feb., Mar., Oct., Nov., Dec.
Superior Steel Products Corp., Apr., July, Sept., Nov.
Trion, Inc., Apr.
Ward Machinery Co., Apr., June, Aug., Sept., Oct., Dec.
West, R. C., Mfg. Co., May.
Whistler, S. B., & Sons, Inc., Apr., June, Aug., Nov.

PORTABLE POWER TOOLS

Acme Tool Co., July.
Hannifin Corp., Feb.
Haskins, R. G., Co., Apr.
Ingersoll-Rand, Inc., Feb., Mar., Apr., June, Aug., Dec.
Jarvis, Charles L., Co., Feb.
Keller Tool Co., Feb., Apr., May, July, Sept., Oct.
Knight, W. B., Machinery Co., June.
Modern Tool Works Division, Jan.
Nobur Mfg. Co., Feb.
Pratt & Whitney, Aug.
Rotor Tool Co., The, Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.

HAND TOOLS

Armstrong Bros. Mfg. Co., Feb., June.
Lassy Tool Co., Aug.
M-B Products, Apr.
Nord International Corp., Apr.
Norton Co., June.
Sturtevant, P. A., Co., Jan., Apr., May, Sept., Nov.
Trig-O-Matic Corp., June.

MARKING EQUIPMENT

Cadillac Stamp Co., Jan., Feb.
Ideal Industries, Inc., July, Nov.
Noble & Westbrook Mfg. Co., Feb., Mar., Apr.
Parker Stamp Works, Aug., Sept., Oct., Nov., Dec.
Schmidt, Geo. T., Co., Feb., July.

LUBRICATING EQUIPMENT & COOLANTS

Air Conversion Research Corp., Jan., Apr., May, July, Sept.
Anderson, F. E., Oil Co., Jan., Feb., Mar., Apr., May, July, Aug., Oct., Dec.
Armour & Co., Mar.
Barnes Drill Co., Apr.
Graymills Corp., Feb., Apr., June, Aug., Oct., Dec.
Gulf Oil Co., Feb., Apr., June, Nov.
Melard Mfg., Corp., Oct.
Motch & Merryweather Machinery Co., The, Sept., Dec.
Norgren, C. A., Co., Apr., June, Aug.
Production Specialties, Inc., Dec.
Ruthman Machinery Co., The, Jan., Feb., Mar., Apr., June, July, Aug., Sept., Oct., Nov., Dec.
Stuart, D. A., Oil Co., Ltd., Feb., Apr., July, Aug., Oct., Dec.
Sun Oil Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.

OTHER METALWORKING EQUIPMENT & MACHINES

American Roller Die Corp., Jan., Feb., Apr., June, Aug., Oct., Dec.
Barry Corp., The, Oct.
Blake, Edward, Co., May.
Chicago Rivet & Machine Co., June.
Cosa Corp., Apr.
Dahlstrom Machine Works, Inc., Nov.
Detroit Power Screwdriver Co., Sept.
Elox Corporation of Michigan, Feb., Mar., Apr., May, July, Aug., Dec.
Gorton, George, Machine Co., Apr.
Green Instrument Co., Inc., Apr.
Henry & Wright, June.
High Speed Hammer Co., Apr.
Ideal Industries, Inc., Nov.
Keller Tool Co., Jan., June.
Kling Bros. Engineering Works, May.
McKay Machine Co., The, Feb., June, Aug., Oct., Dec.
Newage International, Inc., Apr.
Nilson, A. H., Machine Co., The, May, June, Sept., Oct.
O'Neil-Irwin Mfg. Co., Oct.
Sheffield Corp., The, Dec.
Snyder Tool & Engineering Co., Apr.
Swanson Tool & Machine Products, Inc., Nov.
Tomkins-Johnson Co., June.
U. S. Tool Co., The, Feb.
Yoder Co., The, Feb., Mar., May, June, Sept., Oct., Nov.

FORMING, FORGING, CASTING

MECHANICAL PRESSES

Baird Machine Co., July, Sept.
Chicago Rivet & Machine Co., Dec.
Cincinnati Milling Machine Co., Oct.
Clearing Machine Corp., Feb., Apr., June, Aug., Sept., Nov.
General Mfg. Co., Apr., June, Aug., Oct., Dec.
Henry & Wright, Apr.
Niagara Machine & Tool Works, Feb., Apr., Oct.
O'Neil-Irwin Mfg. Co., Feb., Apr., Aug.
Palley-Supply Co., July, Sept., Dec.
Richards, J. A., Co., Jan., Feb., May, June, July, Aug., Sept., Oct., Nov., Dec.
Royal Press Co., Nov.
Service Machine Co., Feb., Mar., Apr., May, June, July, Sept., Oct., Nov., Dec.
Swanson Tool & Machine Products, Inc., Apr.
U. S. Tool Co., The, May, Aug.
V & O Press Co., The, Mar., Apr., June, Aug., Dec.
Verson Allsteel Press Co., Jan., May, July, Sept., Oct., Nov., Dec.
Wiedemann Machine Co., Nov., Dec.

HYDRAULIC PRESSES

Air-Mite, May.
Bellows, Co., The, Jan.
Cincinnati Milling Machine Co., Feb., Apr., June.
Denison Engineering Co., The, July, Sept.
Henry & Wright, Dec.
Niagara Machine & Tool Works, Aug.
Oliver Corporation, Jan., Mar., May, July, Sept.
O'Neil-Irwin Mfg. Co., June.
Palley Supply Co., Mar., Apr., May, June, Aug., Nov.
Verson Allsteel Press Co., July, Oct., Nov.

BRAKES AND SHEARS

American Pullmax Co., Inc., Apr.
Benchmaster Mfg. Co., Aug.
Cincinnati Shaper Co., Feb., Mar., May, June, Aug., Sept., Oct., Nov., Dec.
Dahlstrom Machine Works, Inc., Nov.
Kling Bros. Engineering Works, Mar., Nov.
Littell, F. J., Machine Co., Aug.
Niagara Machine & Tool Works, Apr., June, Dec.
O'Neil-Irwin Mfg. Co., Dec.
Wales-Strippit Corp., Feb.

PLASTIC MOLDERS

Hydraulic Press Mfg. Co., June.

DIE CASTERS

Torrington Co., The, Feb., Apr., Dec.

FORGING EQUIPMENT

Torrington Co., The, June, Aug., Oct.
Wiedemann Machine Co., Oct.

PUNCHING, NOTCHING & NIBBLING MACHINES

American Chain & Cable Co., Apr.
Baird Machine Co., Mar.
Barry Corp., The, Apr.
Chicago Rivet & Machine Co., Feb., Apr., Aug., Oct.
Danly Machine Specialties, Inc., Feb., Apr., June.
Hannifin Corp., July.
High Speed Hammer Co., Apr.
Keller Tool Co., Mar.
Littell, F. J., Machine Co., Aug.
Manco Mfg. Co., Feb., Mar., Apr., June, Aug., Oct.
Niagara Machine & Tool Works, Apr.
O'Neil-Irwin Mfg. Co., Feb.
Service Machine Co., Aug.
Tomkins-Johnson Co., Feb.
Tubular Rivet & Stud Co., Apr.
Wales-Strippit Corp., Jan., Feb., Mar., Apr., May, June, Aug., Oct., Dec.
Whistler, S. B., & Sons, Inc., Feb.
Wiedemann Machine Co., Apr., May, June, July, Aug., Sept.

WELDING AND HEAT TREATING

GAS WELDING AND CUTTING

Lincoln Electric Co., Mar., May, July, Oct., Nov.

ELECTRIC WELDING

Berg Industries, Inc., Port Huron Machine Products, Dec.
Lincoln Electric Co., June.
Yoder Co., The, Dec.

WELDING ACCESSORIES

Erickson Tool Co., Aug.
Handy & Harman, Feb., June, Aug., Oct.

FURNACES AND HEATERS

Induction Heating Corp., Aug.
Lepel High Frequency Laboratories, Mar., May, July, Oct., Dec.
Lindberg Engineering Co., Jan., Feb., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Lindberg Steel Treating Co., Feb., Apr. June.
Ohio Crankshaft Co., The, Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Sentry Co., Feb., Apr., June, Aug., Sept., Dec.
Yoder Co., The, Apr.

LAYOUT AND INSPECTION

GAGES AND TESTING MACHINES

Acme Industrial Co., Feb., Apr., May, July, Nov., Dec.
Acme Scientific Co., Jan., Apr.
Alina Corp., Oct.
American Chain & Cable Co., Wilson Mechanical Instrument Division, Feb., July, Sept., Oct.
American Gage & Mfg. Co., Apr.
Ames, B. C., Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Ames Precision Machine Works, Jan., Mar., May, July, Sept., Nov.
Annis, R. B., Co., Apr.
Barnes, W. F. & John, Co., Apr.
Bath, John, Co., Inc., Nov.
Boice Mfg. Co., Inc., Mar., Apr.
Brown & Sharpe Mfg. Co., Jan., Apr., May.
Brush Electronics Co., Feb., Apr., May, June, Sept., Nov.
Cadillac Gage Co., Oct., Nov.
Chicago Dial Indicator Co., Apr., May.
Comtor Co., Feb., Apr., June, July, Sept., Dec.
Cosa Corp., Apr., Sept.
Dearborn Gage Co., Ellstrom Standards Division, Feb., Apr., June, Aug., Oct., Dec.
Deltronic Corp., May, July, Sept., Nov.
Detroit Tap & Tool Co., Dec.
Eastman Kodak Co., Feb., Apr., June, Oct., Dec.
Edroy Products Co., Feb., Mar.
Ellendy Engineering & Sales, Inc., Sept.
Ercona Corp., Apr.
Federal Products Corp., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Foster Engineering Co., Nov.
Gaertner Scientific Co., Apr., May, June, Oct., Nov.
Gisholt Machine Co., Jan., Feb., Apr., May, June, Dec.
Hanson-Whitney Co., Division of Whitney Chain Co., Apr., July.
Hutchinson, Wm. T., Co., Sept.
Inspection Devices Co., Jan., Apr.
Johnson Gage Co., July, Sept., Nov.
Jones & Lamson Machine Co., May, Aug.
Lincoln Park Industries, Inc., Jan., Mar., May, Sept.
Linde Air Products Co., May.
Machine Products Corp., Dec.
Madison Industries, Inc., Apr.
Merrill Engineering Laboratories, Mar., Apr., May, Sept., Nov.
Merz Engineering Inc., Apr., May.
Micrometrical Mfg. Co., Feb., Apr., June.
Nilsson Gage Co., Inc., Feb., Apr.
Palley Supply Co., Mar., Apr., Sept., Nov.
Perkins-Elmer Corp., Apr.
Pratt & Whitney Division, Niles-Bement Pond Co., Feb., Apr., Aug.
Precision Tool & Mfg. Co. of Illinois, Apr., May.
Reliant Industries, Inc., Nov.
Rimat Tool Co., Feb., Apr., June, Aug.
Robbins, Omer E., Co., Feb.
Ronald Press Co., Oct.
Scherr, Geo., Co., Inc., Jan., Feb., Mar., Apr., May, Sept., Oct., Dec.
Scully-Jones & Co., Apr.
Sheffield Corp., The, Feb., Apr., June, Aug.
Sheldon Machine Co., Jan.
Smit, Anton, & Co., Inc., Jan.
Sorensen Center Mike Corp., Jan., Apr.
Standard Gage Co., Inc., Jan., Feb., Mar., Apr., May, June, July, Sept., Oct., Nov., Dec.
Starrett, L. S., Co., The, Jan., Mar., Apr., July, Sept., Nov.
Steel City Testing Machines, Inc., Jan., Apr.
Taft-Peirce Mfg. Co., The, Mar., Apr., June, July, Aug., Sept., Oct., Dec.
Taylor Dynamometer and Machine Co., Jan., Feb., Mar., Apr., June.
Threadwell Tap & Die Co., Nov.
Tinius Olsen Testing Machine Co., Apr.
Tubular Micrometer Co., Apr.
Van Keuren Co., Feb., Apr., June, Aug., Oct., Dec.
Webber Gage Co., Apr., June, Aug., Oct.
Wilson Mechanical Instrument Division American Chain & Cable Co., Jan., Apr.
Woodworth, N. A., Co., Mar., Apr., May, Sept.

COMPARATORS AND LAYOUT EQUIPMENT

Acme Industrial Co., Aug.
Acme Tool Co., Feb., Apr., May, June, Sept.
Dykem Co., The, Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Eastman Kodak Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Gaertner Scientific Co., Aug.
Hardinge Brothers, Inc., July.
Lee, K. O., Co., July.
Machine Products Corp., Aug.
Optical Gaging Products, Inc., Jan., Apr.
Portage Double-Quick Tool Co., June, Dec.
Precision Tool & Mfg. Co. of Illinois, Mar., June, July, Aug.
Rahn Granite Surface Plate Co., Apr., July, Oct.
Robbins, Omer E., Co., June, Dec.

Scherr Co., Inc., June, July, Aug., Nov.
Taft-Peirce Mfg. Co., The, Jan., Feb., Apr., May, [illegible] Sept., Nov.

CLEANING, FINISHING AND CHEMICAL TESTING

POLISHING

Behr-Manning Corp., Nov.

CLEANING

Cro-Plate Co., Inc., The, Mar., Apr., July.
Gulf Oil Corp., Oct.
Modern Industrial Engineering Co., Feb.
Oakite Products, Inc., Jan., Feb., Mar., Apr., June, July, Aug., Sept., Oct., Nov., Dec.
Osborn Mfg. Co., The, Apr., June, Aug., Oct., Dec.
Phillips Mfg. Co., Apr.
Vapor-Blast Mfg. Co., Mar., Apr.

FINISHING

Lincoln Park Industries, Inc., July.
Linde Air Products Co., July.
National File Co., July, Aug., Sept., Nov., Dec.

PLANT SERVICE EQUIPMENT

INDUSTRIAL TRUCKS

Barry Corp., The, May.
Jacobs Mfg. Co., May.

CONVEYORS

American Monorail Co., Aug., Sept., Oct., Nov.
Barnes, W. F. & John, Co., Apr.
Chicago Tramrail Corp., Apr.
Hapman Conveyors, Inc., Jan.

MISC. MATERIAL HANDLING

Barnes, W. F. & John, Co., Apr.
Basco Mfg. Corp., Apr.
Denison Engineering Co., Apr.
Keller Tool Co., Dec.
Sahlin Engineering Co., Apr.

PUMPS

Denison Engineering Co., Apr.
Hydraulic Press Mfg. Co., Hydraulic Power Division, Feb.
Palley Supply Co., Mar., Apr., Oct.

AIR COMPRESSORS, CLEANERS

Cro-Plate Co., Inc., The, Jan., Feb., May.
Hannifin Corp., May, Nov.

DRAFTING AND BLUEPRINTING

Mayline Co., Feb., Apr., June, Aug., Oct., Dec.
RapiDesign, Inc., May.
Wallington Sales Co., Dec.

MISCELLANEOUS

Barry Corp., The, June, Dec.
Bodine Corp., The, Apr.
Boston Gear Works, Feb.
Cross Co., The, June.
Dazor Mfg. Corp., Apr.
Hammond Machinery Builders, Inc., Jan.
Osborn Mfg. Co., The, Feb.

PARTS AND MATERIALS

ELECTRICAL

Barnes, W. F. & John Co., Apr.
Baush Machine Tool Co., Apr.
Doerr Electric Corp., Apr.

MECHANICAL

Boston Gear Works, June, Nov.
Bunting Brass & Bronze Co., The, Apr.
Danly Machine Specialties, Inc., Nov.
Ferguson Machine & Tool Co., Apr., Oct., Nov.
Hansen Mfg. Co., The, Apr.
Logansport Machine Co., Inc., Oct.
Machine Products Corp., Aug., Oct.
Nice Ball Bearing Co., Apr., Nov.
Ohio Knife Co., The, Mar.
Ortman-Miller Machine Co., May.
Parkwood Laminates, Inc., May.
Ready Tool Co., Oct.
Service Machine Co., Jan.
Vlier Eng. Co., Feb.

HYDRAULIC

Anker-Holth Division, Wellman Eng. Co., June, Oct.
Baush Machine Tool Co., Apr.
Bellows Co., The, July.
Denison Engineering Co., Apr., Aug., Oct., Nov., Dec.
Ex-Cell-O Corp., Nov.
Galland-Henning Mfg. Co., Feb., Aug., Oct.
Hanna Engineering Works, Apr., June, Oct.
Hannifin Corp., Jan., May, June, Sept., Oct., Nov., Dec.
Hydraulic Press Mfg. Co., Hydraulic Power Division, Jan., Mar., Apr., June, Aug., Sept., Nov.
Lindberg Engineering Co., Apr.
Logansport Machine Co., Inc., June, Aug., Dec.
Miller Fluid Power Co., Feb., Mar., Apr., May, June, July, Aug., Sept., Nov., Dec.
Modernair Corp., Sept.
Ortman-Miller Machine Co., Mar., Apr., June, July, Aug., Sept., Oct., Nov., Dec.
Palley Supply Co., Apr., June, Sept., Nov., Dec.
Rivett Lathe & Grinder Co., Inc., Jan., Feb., Mar., Apr., June, Aug., Oct., Nov.
S-P Mfg. Corp., Feb., Mar., Sept.
Tomkins-Johnson Co., Feb., Aug., Oct.
Wellman Engineering Co., Anker-Holth Division, Feb., Apr., Aug.

PNEUMATIC

Air-Mite, Jan., Oct.
Bellows Co., The, Feb., May, June, Aug., Oct., Nov., Dec.
Galland-Henning Mfg. Co., Feb., June, Aug., Oct., Dec.
Hanna Engineering Works, Apr.
Hannifin Corp., Jan., Mar., Apr., Aug., Oct.
Keller Tool Co., Aug., Nov.
Lindberg Engineering Co., Apr.
Littell, F. J., Machine Co., Apr.
Logansport Machine Co., Feb., June.
Mead Specialties Co., Apr.
Miller Fluid Power Co., Jan., Mar., Apr., June, Aug., Sept., Oct., Nov., Dec.
Modernair Corp., Sept., Nov.
Ortman-Miller Machine Co., Jan., Feb., Mar., Apr., July, Aug., Sept., Oct., Nov., Dec.
Palley Supply Co., Dec.
Rivett Lathe & Grinder Co., Inc., Mar., Dec.
S-P Mfg. Corp., Jan., Feb., Mar., Apr., Nov.
Schrader's, A., Son, Division of Scoville Mfg. Co., Jan., Mar., Apr., July, Sept., Nov.
Tomkins-Johnson Co., Feb., Aug.
Valvair Corp., Apr., May, June.
Wellman Engineering Co., Anker-Holth Division, Feb., Aug., Dec.

FASTENING DEVICES

Allen Mfg. Co., Feb., Apr., June, Aug., Dec.
Aviation Developments, Inc., Aug.
Bristol Co., The, Feb., Mar., Apr., May, July, Sept., Nov.
Cleveland Cap Screw Co., Apr., May, July, Sept., Oct., Dec.
Hassall, John, Inc., July, Dec.
Milford Rivet & Machine Co., Mar., Apr.
Ottemiller, Wm. H., Co., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Parker-Kalon Corp., Feb., Apr., June, Sept., Nov.
S'ewek Tool Co., Mar., Apr.
Standard Pressed Steel Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Strong, Carlisle & Hammond Co., Mac-It Screw Department, Apr.
Vlier Engineering, Inc., July, Sept., Nov.

MATERIALS

Nice Ball Bearing Co., Aug.

a. Tool and Die

Acme Industrial Co., Jan., Mar.
Adamas Carbide Corp., Apr., Oct., Dec.
Allegheny Ludlum Steel Corp., Jan., Mar., July, Aug., Sept., Oct., Nov., Dec.
B-M-S Carbide Specialties, Inc., Apr., June.
Bakelite Co., A Division of Union Carbide & Carbon Corp., Nov.
Bethlehem Steel Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Carboloy, Department of General Electric Co., Apr., Aug., Oct., Dec.
Carpenter Steel Co., Jan., Mar., Apr.
Cerro de Pasco Corp., Feb., Aug.
Columbia Tool Steel Co., Jan., Apr., May, June, July, Aug., Sept., Oct., Nov.
Crucible Steel Company of America, Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Darwin & Milner, Inc., Jan., Mar., Apr., June, Aug., Dec.
Firth-Sterling, Inc., Jan., Mar., July, Sept., Nov.
Haynes-Stellite Co., A Division of Union Carbide & Carbon Corp., Apr., May, Dec.
Hutchinson, Wm. T., Co., Nov.
Jessop Steel Co., Feb., Apr., May, Sept., Oct., Nov.
Latrobe Steel Co., Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.
Metal Carbides Corp., May, June, Aug., Oct., Nov., Dec.
Milne, A., & Co., Mar., Apr., Dec.
Ohio Knife Co., The, Apr., May.
Parkwood Laminates, Inc., Mar.
Pittsburgh Tool Steel Wire Co., Apr.
Rezolin, Inc., Apr.
Simonds Saw & Steel Co., Mar., June, Nov.
Standard Parts Co., May.
Timken Roller Bearing Co., Feb., Apr., Aug., Dec.
Uddeholm Company of America, Inc., Oct., Nov.
Union Carbide & Carbon Corp., Mar.
Vanadium-Alloys Steel Co., Jan., Apr., June, Aug., Sept., Nov.
Vlier Engineering, Inc., May.
Ziv Steel & Wire Co., Apr.

b. Product

Adamas Carbide Corp., Jan., Mar.
American Brass Co., The, Feb., Apr., May, June, July, Sept., Dec.
Ampco Metal, Inc., Apr., June, Sept., Nov.
Aviation Developments, Inc., Dec.
B-M-S Carbide Specialties, Inc., Apr.
Bagshaw, W. H., Co., Inc., Dec.
Bakelite Co., A Division of Union Carbide & Carbon Corp., Nov.
Boston Gear Works, Sept.
Brown & Sharpe Mfg. Co., Nov.
Cadmet Corp., Apr., Aug., Oct., Dec.
Carboloy, Department of General Electric Co., Apr., June.
Cerro de Pasco Corp., Apr., June, Oct., Dec.
Handy & Harman, Inc., Apr., Nov.
Hansell-Elcock Co., Jan.
Jessop Steel Co., Mar.
Meehanite Metal Corp., Feb., Apr., June, Sept.
Metal Carbides Corp., Feb., Mar., Apr., May, Sept., Nov.
Ohio Knife Co., The, Sept.
Parkwood Laminates, Inc., Jan.
Timken Roller Bearing Co., June, Oct.
Wheelock, Lovejoy Co., Feb., Apr., June, Aug., Oct., Dec.

TECHNICAL AND EDUCATIONAL SERVICES

ENGINEERING SERVICES

Berg Industries, Inc., Port Huron Machine Products, Apr., June, Aug., Oct.
Die Techniques, Publishing Co., Falcon Engineering Co., Feb.
Hayes Aircraft Corp., Jan.
Jones & Lamson Machine Co., Aug. Dec.
Motch & Merryweather Machinery Co., The, Sept.
Pioneer Eng. & Mfg. Co., Mar., May, Sept., Oct., Dec.

PUBLICATIONS

Adamas Carbide Corp., Sept., Nov.
Allegheny Ludlum Steel Corp., May, June.
American Society of Tool Engineers, Jan., Apr., May, Dec.
Atrax Co., The, Apr.
Bennett, Chas. A., Co., Oct.
Berg Industries, Inc., Port Huron Machine Products, May.
Bliss, E. W., Co., Feb.
Crucible Steel Company of America, Feb.
Darwin & Milner, Inc., Oct.
Denison Engineering Co., Jan., Feb.
Die Techniques Publishing Co., Falson Engineering Co., Apr., June, Aug.
Everede Tool Co., Feb.
Hassall, John, Inc., Mar.
Kling Bros. Engineering Works, Sept.
Oakite Products, Inc., Feb., May.
Palley Supply Co., Feb., Apr.
Ronald Press Co., Jan.
Standard Parts Co., Jan., Feb., Mar., Apr., June.
Verson AllSteel Press Co., Mar.
Waldes Kohinoor, Inc., June.

Index of The Tool Engineer Advertisers

January 1955 Issue

The Index to Advertisers is published as a reader service. Although every precaution is taken to assure correct listing, no allowance will be made for error or omission.

*Exhibitor in 1954 ASTE Industrial Exposition

♦User of ASTE Data Sheets

L

M

N

O

P

R

S

T

U

V

W

Z

THE TOOL ENGINEER REGIONAL ADVERTISING OFFICES

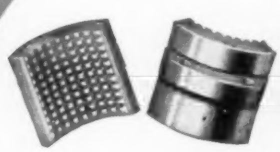
here's how...

BALAS MASTER COLLETS

Save you money!

MASTER COLLET
$47.60 NET

It's not necessary to buy a solid collet for every size of bar stock. All you need is a Balas Master Collet and several sets of pads and you can take advantage of the full capacity of your machines. A set of pads costs about a third as much as a solid collet of equal capacity. These savings add up to substantial profits.



COLLET PADS
$14.40 NET

Balas Martin or "CB" type Master collet pads are inserted into the collets without removing them from the spindle saving several hours and many dollars on each set up!!!

Balas Master Collets assure better production... less scrap ...more profitable operation since rigid inspection guarantees maximum concentricity. They are built from high carbon, alloy tool steel for ruggedness and dependability. Our large stock of standard types and sizes means you get fast delivery. Always order Balas...no other collet gives you equal economy and performance.

SOLID COLLET
$37.80 NET

BALAS also makes:

- Pushers and Feed Fingers
- Master Pushers and Pads
- Master Collets and Pads
- Ejector Collets
- Collet Sleeves and Chuck Nuts for B. & S. Machines
- Carbide-faced Stock Stops for B. & S. Machines

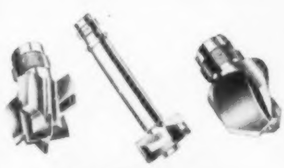
BALAS

COLLET MANUFACTURING CO.

CLEVELAND 14, OHIO

REPRESENTATIVES: George Britton, Brockport, N. Y.; Bert Lewyn, Atlanta, Ga.; L. R. Christiansen Co., Moline, Ill.; John C. Eide Co., Minneapolis, Minn.; Ralph Fannin, Houston, Texas; Fuchs Machinery & Supply, Omaha, Neb.; Frederic & Baker, Shreveport, La.; Hoffman Baumruck Co., Philadelphia, Pa.; Hunker & Dixon, Indianapolis, Ind.; Industrial Tool Supply, Oakland, Calif.; Harvey A. Wolff, Milwaukee, Wisc.; S. B. Martin Co., Cleveland, Ohio; Morris Machinery Co., Newark, N. J.; Paul & Dudley, Glendale, Calif.; John S. Pettit, Madison, Conn.; L. E. Rogers Co., Chicago, Ill.; Scott Special Tools, St. Louis, Mo.; Shively Bros., Inc., Flint, Mich.; Tool Specialists, Westbury, N. Y.; Arthur Williams, Beaverton, Ore.; Iver J. Esbenson Co., Denver, Colo.; T. M. Welborn Co., Greenville, S.C.; A. C. Behringer, Inc., Los Angeles, Calif.; Alexander & Orlick, Ltd., Brantford, Ontario; Upton, Bradeen & James, Montreal, Canada.

CONTINENTAL COUNTERBORES



Continental Counterbores may be purchased individually or in sets. Selection of three sets available. Write for new Counterbore Catalog.

THESE FEATURES WILL SAVE YOU TIME AND SAVE YOUR TOOLS:

Hand Detachable—one quarter turn by hand, ***a twist of the wrist*** engages or releases cutter.

Balanced Drive—*double* lugs on cutter engage *double* abutments in holder; *double* aligning bearings for rigidity.

Extra Torsional Rigidity—drive lugs are close to seating shoulder of cutter.

Practically Indestructible—driving forces apply compression, not shearing action.

Right or Left Hand—one quarter turn locks or releases either right- or left-hand cutters.

Outside of Holder Free from Obstructions—obtainable for piloting in bushing, fluted to remove chips or threaded for stop nuts or collars.

The Continental Drive is available in standard counterbores, spot facers, countersinks, and also on special tools such as multiple-diameter cutters, step counterbores, radius and chamfering applications. It is equally applicable for inverted operations. Order through your Ex-Cell-O representative or direct from Continental Tool Works in Detroit.

CONTINENTAL TOOL WORKS
CTW
EX-CELL-O CORPORATION

Other Continental Products: Standard and Special Cutting Tools, Broaches and Broach Fixtures.

CONTINENTAL TOOL WORKS

Division of Ex-Cell-O Corporation, Detroit 32, Michigan

54-28